Carleton University
Department of Systems and Computer Engineering
SYSC 2310 – Introduction to Digital Systems – Fall 2019
Mondays & Wednesdays 11:35 am - 12:55 pm @ Unicentre 231
Course Outline

Instructor Information and Office hours

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TA Information and Office hours

- Alexander Fernandes
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  Lab: L1E & L1O (Mondays 2:35 pm - 5:25 pm @ CB5109)
- Ismael Al-Shiab
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  Lab: L1E & L1O (Mondays 2:35 pm - 5:25 pm @ CB5109)
- Odai Salman
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  Lab: L3E & L3O (Wednesdays 2:35 pm - 5:25 pm @ CB5109)
- Thomas Sattolo
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  Office Hours: Wednesdays 1:30 pm - 2:30 pm @ CB5101
  Lab: L3E & L3O (Wednesdays 2:35 pm - 5:25 pm @ CB5109)
- Sameh Ibrahim
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  Office Hours: Thursdays 2:30 till 3:30 @ TBD
  Lab: L2E & L2O (Fridays 11:35 am - 2:25 pm @ CB5109)
- Sina Salsabili
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  Office Hours: Fridays 2:30 am - 3:30 pm @ TBD
  LAB: L2E & L2O (Fridays 11:35 am - 2:25 pm @ CB5109)
- Madison Cohen-McFarlane (Grading)
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Calendar Information

- *Course Number:* SYSC2310
- *Course Title:* Introduction to Digital Systems
- *Calendar description:* Number systems: binary, decimal, hexadecimal. Digital representation of information. Computer arithmetic: integer, floating point, fixed point. Boolean logic, realization as basic digital circuits. Applications: simple memory circuits, synchronous sequential circuits for computer systems. Finite state machines, state graphs, counters, adders. Asynchronous sequential circuits. Races.

Prerequisites

- (ECOR 1051 and ECOR 1052 and ECOR 1053 and ECOR 1054) or ECOR 1606 or SYSC 1005, and enrollment in Computer Systems Engineering, Communications Engineering, or Software engineering, and second-year status in Engineering.
- In addition, it would be helpful if the students have a basic understand of the ordinary mathematical system and algebra.
- Students who have not satisfied the prerequisites for this course must either withdraw from the course or obtain a prerequisite waiver by visiting the Engineering Undergraduate Academic Support Office.

Course Objectives

The objective of this course is to provide knowledge on fundamentals of digital systems. In the design and implementation of digital systems, all information is encoded, processed and communicated as binary values (i.e. using 0's and 1's). These systems are built from simple digital logic gates that manipulate binary values. Digital memory circuits are used to store binary values over time. Digital systems frequently utilize finite state machines to control the manipulation of information as a sequence of steps. A clock is often used to control the pace of data processing and communication. Although a clock provides a well-defined reference for sequencing steps, circuits can sometimes be designed to operate asynchronously (i.e., without a clock) to speed up processing.

Learning Outcomes

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

1. Define concepts of digital representation of information.
2. Ability to work effectively with a variety of number systems and numeric representations, including signed and unsigned binary, hexadecimal, two's complement, fixed point, and floating point.

3. Understand the basic building blocks of digital systems.
4. Understand Boolean Algebra and formulate, analyze and simplify Boolean functions.
5. Apply analysis skills to correctly describe the behavior of given combinational and sequential digital logic circuits.
6. Able to design, implement and analyze combinational logic with digital gates and sequential circuits with flip-flops.
7. Capable of designing and implementing simple finite state machines.

Graduate Attributes (GA's)

The Canadian Engineering Accreditation Board requires graduates of engineering programs to possess 12 attributes at the time of graduation. Activities related to the learning outcomes listed above are measured throughout the course and are part of the department's continual improvement process. Graduate attribute measurements will not be taken into consideration in determining a student's grade in the course. For more information, please visit: https://engineerscanada.ca/.

Graduate Attribute	Learning Outcome (s)
1.7.S Knowledge Base: Electronics and circuits	1-7
2.1 Problem Analysis: Problem definition	2-7
4.6 Design: Alternate solution(s) definition	4-7
4.7 Design: Evaluation based on engineering principles	4-7
5.1 Use of Engineering Tools: Diagrams and engineering sketches	5-7

Textbooks (or other resources)

- No textbook is required for this course. Course material and all other instructional materials will be posted on the course webpage through cuLearn. Students are expected to check this page frequently.
- All course material and instructional materials are covered by the rules stipulated in *Copyright on Course Materials* of General Regulations section below.
- *Recommended Additional Reading:* "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog, 6th Edition Mano & Ciletti ©2018 | Pearson | ISBN-13: 9780134549897"
- *Links to Software, libraries, additional resources:*
  For practicing basic digital design with common logic gates and verifying the design via simulation, a simple simulator is used. Logisim is a free software. It is a Java-based visual simulator for simple digital circuits. Instructions for download as well as a brief description of its use will be provided as part of the course material in cuLearn.

Evaluation and Grading Scheme

The course work will be evaluated as follows:

Component	Percentage
Labs	15%
Quizzes	10%
Midterm	25%
Final Exam	50%

Breakdown of course requirements (labs, quizzes and exams)

Labs
There will be a series of graded three-hour labs during the term.

- Full attendance to the assigned lab sessions is mandatory and will be monitored throughout the term. Students are required to demonstrate their work by the end of the lab period. Only work submitted during the assigned lab period of each student will be marked.
- Labs will be posted on cuLearn.
- The lab is open 7 days a week, whenever the building is open. Except for those timetable slots when the room is reserved for specific courses, the lab can be used any time.
- If one lab is missed, with a valid medical certificate, a mark equal to the average of the other labs will be given. The medical certificate must adhere to the format required by the Registrar. The format is available through the Registrar's website http://www.carleton.ca/registrar/forms. All medical certificates must be presented immediately upon return from the illness; they will not be accepted after the fact. If sending a medical certificate by e-mail, students are responsible to ensure that a receipt confirmation is received within 3 days. Further absences will result in a mark of zero for the missed labs, unless valid documentation of a prolonged illness is provided.
- There are no make-up labs.

Exams

- No calculators or external aids will be allowed during the exams.
- Midterm: During the lecture on Oct. 16.
- Final Exam: TBD.
- The final examination is for evaluation purposes only and will not be returned to students. You will be able to make arrangements with the instructor or with the department office to see your marked final examination after the final grades have been made available.

Week-by-Week breakdown

1. Introduction
2. Information representation
3. Digital systems and binary numbers. Basic logic gates.
4. Boolean algebra
5. Gate-level minimization
6. Combinational logic
7. Combinational logic (cont.)
8. Sequential circuits: Latches and flip-flops
9. Synchronous sequential circuits: Counters, Registers, Memory
10. Synchronous sequential circuits: Finite state machines. Multiplication and division
11. Asynchronous circuits
12. Course review

General Regulations

Attendance: Students are expected to attend all lectures and lab periods. The University requires students to have a conflict-free timetable. For more information, see the current *Undergraduate Calendar, Academic Regulations of the University, Section 2.1.3, Course Selection and Registration and Section 2.1.7, Deregistration.*

Health and Safety: Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: http://sce.carleton.ca/courses/health-and-safety.pdf

Deferred Term Work : Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases this must occur no later than three (3.0) working days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. For more information, see the current *Undergraduate Calendar, Academic Regulations of the University, Section 4.4, Deferred Term Work.*

Appeal of Grades: The processes for dealing with questions or concerns regarding grades assigned during the term and final grades is described in the *Undergraduate Calendar, Academic Regulations of the University, Section 3.3.4, Informal Appeal of Grade and Section 3.3.5 Formal Appeal of Grade.*

Academic Integrity: Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at: https://carleton.ca/registrar/academic-integrity/. This site also contains a link to the complete Academic Integrity Policy that was approved by the University's Senate.

Plagiarism: Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated.

Academic Accommodation: You may need special arrangements to meet your academic obligations during the term. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www.carleton.ca/equity/ For an accommodation request, the processes are as follows:

- **Pregnancy or Religious obligation**: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf

- **Academic Accommodations for Students with Disabilities**: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your ***Letter of Accommodation*** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (*if applicable*). **Requests made within two weeks will be reviewed on a case-by-case basis**. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the

PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (*if applicable*).

- **Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/sexual-violence-support/.

- **Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf

Week	Monday	Wednesday
1		Sept. 4 Lect.
2	Sept. 9 Lect.	Sept. 11 Lect.
3	Sept. 16 Lect.	Sept. 18 Lect.+Quiz
4	Sept. 23 Lect.	Sept. 25 Lect.
5	Sept. 30 Lect.	Oct. 2 Lect.+Quiz
6	Oct. 7 Lect.	Oct. 9 Lect.
7	Oct. 14 Holiday	Oct. 16 Midterm
8	Oct. 21 to Oct. 25 Fall Break	
9	Oct. 28 Lect.	Oct. 30 Lect.
10	Nov. 4 Lect.	Nov. 6 Lect.+Quiz
11	Nov. 11 Lect.	Nov. 13 Lect.
12	Nov. 18 Lect.	Nov. 20 Lect.+Quiz
13	Nov. 25 Lect.	Nov. 27 Lect.
14	Dec. 2 Lect.	Dec. 4 Lect.+Quiz