COMP ENG 3DQ5
Digital Systems Design
Fall 2019
Course Outline

CALENDAR/COURSE DESCRIPTION

Advanced design methods of digital systems including modelling, simulation, synthesis and verification using hardware description languages, timing analysis and hardware debugging; implementation of computer peripherals in programmable devices.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in any Computer Engineering or Electrical Engineering Program, COMPENG 2DI4 or ELECENG 2DI4; and COMPENG 2DP4, or permission of the instructor.
Antirequisite(s): COMPENG 3DQ4

SCHEDULE

Lectures: Tuesday 9:30 am – 11:20 am and Friday in 9:30 am – 10:20 am T13-125
Tutorial: Friday 10:30 am – 11:20 am in T13-125
Labs: Weekly in ITB-AB109 from 2:30 pm to 5:20 pm (L01 Tuesday, L02 Wednesday, L03 Thursday)

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Nicola Nicolici
ITB-A210
nicolici@mcmaster.ca
ext. 27598

Office Hours:
Thursday 1:30 pm – 2:20 pm
or by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

- Pooyan Mehrrvazy mehvarp@mcmaster.ca
- Trevor Pogue poguete@mcmaster.ca
- Stefan Dumitrescu dumits@mcmaster.ca
- Vincent Cheung cheunphv@mcmaster.ca
- Prakhar Garg gargp2@mcmaster.ca

TA office hours are held in ITB-AB109 on Fridays between 2:30 and 5:20 pm after the in-lab experiments for a lab were done and Mondays between 2:30 and 5:20 pm before the take-home exercises for a lab are due; during the project phase of the course further announcements will be made concerning TA office hours.

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://www.ece.mcmaster.ca/~nicola/3dq5/2019

COURSE OBJECTIVES

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

- Analyze and model complex digital circuits using hardware description languages (HDLs)
- Understand design, verification and implementation methods for digital circuits and systems
- Learn how to perform as a practitioner by developing an idea (algorithm) into a working prototype (system)

ASSUMED KNOWLEDGE

Students should be knowledgeable of the digital representation of electrical signals, number systems, operation of the basic logic gates (AND, OR, …), combinational logic blocks (multiplexer, adder/subtractor, …), sequential elements (latches, flip-flops, …), sequential logic blocks (counters, shift registers, …), and know how to design finite-state-machines (FSMs).

COURSE MATERIALS

Required Texts: There is **NO** textbook used in this course. The main sources of information are labs, lectures and tutorials.

Calculator:
No calculator will be allowed during tests and examinations.

COURSE OVERVIEW

Weeks	Topic	Readings
1 to 6	Programmable Logic	Lecture Notes
1 to 6	Design Synthesis	Lecture Notes
7 and 12	Design Verification	Lecture Notes
7 and 12	Implementing Algorithms in Hardware	Lecture Notes
13	Review	Lecture Notes

Please check the course website regularly. At certain points in the course it may make good sense to modify the schedule. The instructor may modify elements of the course and will notify students accordingly (in class, on the course website).

LABORATORY OVERVIEW

Date/Week	Topic	Readings
Sep 9 / 2	Lab 1. Introduction to Computer-Aided Design using Verilog	Lab Manual
Sep 16 / 3	Lab 2. Finite State Machine Design for the PS/2 and LCD interfaces	Lab Manual
Sep 23 / 4	Lab 3. Implementation and Utilization of a VGA Interface	Lab Manual
Sep 30 / 5	Lab 4. Embedded Memories and an External SRAM interface	Lab Manual
Oct 7 / 6	Lab 5. Integrating SRAM, VGA and UART Interfaces	Lab Manual
Oct 21 / 7	Project	Project Description
Oct 28 / 8	Project	Project Description
Nov 4 / 9	Project	Project Description
Nov 11 / 10	Project	Project Description
Nov 18 / 11	Project	Project Description
Nov 25 / 12	Project Cross Examination	

LABORATORY OPERATION

The lab is located in ITB/AB109. There will be five lab sessions and one **comprehensive project**. The labs will cover implementation of control and data path circuitry in programmable logic devices; video signal generation; controllers for data transmission. The project requires that you design, verify and implement an integrated digital system for signal processing. The project demonstrations are mandatory and will be done in the week of November 25th during regular lab timeslots. For more info, please check the course website regularly.

You are allowed to work in groups of two. For all the deliverables, five labs and one project, you must submit not only written reports, but also your source files. It is very important to note that, unless explicitly stated in the lab report, it is assumed that each group member has contributed to all the design/implementation/verification decisions for every take-home exercise. This implies that, when cross-examined, each group member is expected to answer **any** question. If it is explicitly stated what was the contribution of each group member then the grades will be scaled accordingly.

Students are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process, in particular during, but not limited to, the group work for lab and project deliverables. Note, it is forbidden for these deliverables (including source code, design files, lab/project reports) to be shared in any public or private repositories. Only the two partners from the same group should have access to their own group's deliverables.

It is important to note that lab and project marks are **provisional until the final exam** is written in December 2019 because they are subject to an audit (including, but not limited to, an oral cross-examination).

ASSESSMENT

Component	Weight
Quiz	5%
Midterm	15%
Final Exam	30%
Labs	17%
Project	33%
Total	100%

In addition to the final exam, there will be one in-class quiz on Tuesday September 10th at 9:30 am (during the lecture) and one midterm on Monday October 21st at 6:30 pm (location will be confirmed on the course website in due time). Students who miss the quiz, and who have a valid excuse, will have a 5% larger weight allocated to the final examination component of the final grade. Students who miss the midterm, and who have a valid excuse, will be subjected to a make-up test. Anything (worth credit) missed without a valid excuse will be given zero marks. Please note that the instructor reserves the right to choose the format (e.g., written or oral) of any deferred midterm or exam in this course. Announcements concerning any type of graded material may be made in **any** format (e.g., announcements may be made only in class).

Conversion from percentage to letter grade will be by way of the standard scale used in the Office of the Registrar. To pass the course you must also obtain at least 40% on the final examination and at least 40% on the project. Statistical adjustments will not normally be used.

ACCREDITATION LEARNING OUTCOMES

Note: The *Learning Outcomes* defined in this section are measured throughout the course and form part of the Department's continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student's actual grade in the course. For more information on accreditation, please ask your instructor or visit: http://www.engineerscanada.ca .

Outcomes	Indicators	Measurement Methods(s)
Applies ethical frameworks and reasoning in situations where there may be conflicting interests among the stakeholders	10.2	For the labs, any issues concerning the collaboration between group members (and in between different groups) has to be brought to the attention of the instructor before, rather than after, the lab submission. For the course project, students will be requested to acknowledge in the report the contribution of each group member, as well as the nature of interaction with other groups. They will also need to state in the report all the sources of design decisions/ideas, including the ones received from the instructor or teaching assistants.
Demonstrates an understanding of legal requirements governing engineering activities (including but not limited to personnel, health, safety, and risk issues)	8.2	Students are introduced to the health and safety principles. Then, before the first lab is started, they will be quizzed to make sure they have understood them properly.
Communication Skills (i.e. Technical reports)	7.2	Section from project report describing the implementation details and engineering decisions are used for assessment.
Plans and effectively manages time, resources, and scope	11.2	Students are asked to provide a Gantt chart that represents tasks they have completed in each week of the five-week project.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at www.mcmaster.ca/academicintegrity.

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

ACADEMIC ACCOMMODATIONS

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca . For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to the Engineering Student Services office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

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EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, Avenue to Learn and/or McMaster email.

ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK

In this course, we will be using Avenue to Learn. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

Electrical and Computer Engineering Lab Safety

Information for Laboratory Safety and Important Contacts

This document is for users of ECE instructional laboratories in the Information Technology Building.

This document provides important information for the healthy and safe operation of ECE instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in ECE. It is expected that revisions and updates to this document will be done continually. A McMaster University lab manual is also available to read in every laboratory.

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following:

1. Food and beverages are not permitted in the instructional laboratories.
2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
3. Laboratory equipment should only be used for its designed purpose.
4. Proper and safe use of lab equipment should be known before using it.
5. The course TA leading the lab should be informed of any unsafe condition.
6. The location and correct use of all available safety equipment should be known.
7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.
8. Proper waste disposal procedures should be followed.

Location of Safety Equipment

Fire Extinguisher
On walls in halls outside of labs

First Aid Kit
ITB A111, or dial “88” after 4:30 p.m.

Telephone
On the wall of every lab near the door

Fire Alarm Pulls
Near all building exit doors on all floors

Who to Contact

Emergency Medical / Security: On McMaster University campus, call Security at extension **88** or **905-522-4135** from a cell phone.
Non-Emergency Accident or Incident: Immediately inform the TA on duty or Course Instructor.
University Security (Enquiries / Non-Emergency): Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.
See TA or Instructor: For problems with heat, ventilation, fire extinguishers, or immediate repairs
Environmental & Occupational Health Support Services (EOHSS): For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.
ECE Specific Instructional Laboratory Concerns: For non-emergency questions specific to the ECE

In Case of a Fire (Dial 88)

When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout "*Fire!*" and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.
6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire

Do not use a fire extinguisher on people

1. Douse with water from safety shower immediately or
2. Roll on floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

Equipment Failure or Hazard

Failure of equipment may be indicative of a safety hazard - You must report all incidents.

Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:

1. Immediately discontinue use of the equipment.
2. In Power Lab, press wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

Protocol for Safe Laboratory Practice

Leave equipment in a safe state for the next person - if you're not sure, ask!

In general, leave equipment in a safe state when you finish with it. When in doubt, consult the course TA.

Defined Roles

TA	The first point of contact for lab supervision	
ECE Lab Supervisor	Steve Spencer - ITB 147	steve@mail.ece.mcmaster.ca
ECE Chair	Tim Davidson - ITB A111	davidson@mcmaster.ca
ECE Administrator	Kerri Hastings - ITB A111	hastings@mcmaster.ca
ECE Course Instructor	Please contact your specific course instructor directly	

The Department of Electrical & Computer Engineering website:

www.eng.mcmaster.ca/ece