

# ENGG\*2410 - Digital Systems Design Using Descriptive Languages

## Fall 2024 Course Outline

**Section: 01**

**Credits: 0.50**

## Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

## Calendar Description

Review of Boolean algebra and truth tables, Karnaugh maps. Design, synthesis and realization of combinational circuits. Design, synthesis and realization of sequential circuits. VHDL: structural modeling, data flow modeling, synchronous & asynchronous behavior descriptions, algorithmic modeling. Designing with PLDs. Digital design with SM charts. Designing with PGAs and complex programmable logical devices. Hardware testing and design for testability. Hierarchy in large designs. The course will primarily be concerned with the design of multi-input, multi-output digital controllers which provide the central control signals that orchestrate the collection of hardware devices (from SSI to VLSI) found in a digital system. An introduction to FPGA-based, as well as microprocessor-based digital systems design will be given. Design examples will include systems such as UART, microcontroller CPU, ALU and data acquisition system.

**Prerequisite(s):** PHYS\*1130, (1 of CIS\*1300, CIS\*1500, ENGG\*1410)

**Restriction(s):** This is a Priority Access Course. Enrolment may be restricted to the CENG and ESC specializations in the BENG and BENG:C programs. See department for more information. Non-BENG students may take a maximum of 4.00 ENGG credits.

**Department(s):** School of Engineering

## Course Description

This course is an introductory course in digital logic design, which is a basic course in most electrical and computer engineering programs. The main goals of the course are (1) to teach students the fundamental concepts in classical manual digital design and (2) to illustrate clearly the way in which digital circuits are designed today, using CAD tools.

## Lecture Schedule

TuTh 4pm-5:20pm in ALEX\*100 (9/5 to 12/13)

## Timetable

### Lectures

Day	Time	Location	Instructor
Tuesday	4:00 PM - 5:20 PM	ALEX 100	Shawki Areibi
Thursday	4:00 PM - 5:20 PM	ALEX 100	Shawki Areibi

### Seminars (Tutorials)

Day	Time	Location	GTA
Tuesday	13:30 PM - 14:20 PM	MINS 017	TA#1
Tuesday	14:30 PM - 15:20 PM	MCKN 233	TA#2
Wednesday	16:30 PM - 17:20 PM	MCKN 233	TA#3
Thursday	14:30 PM - 15:20 PM	MINS 017	TA#4

## Laboratory

Day	Time	Location	GTA	Email
Monday	9:30 AM - 11:20 AM	RICH 1532	TA#1	-----@uoguelph.ca
Tuesday	8:30 AM - 10:20 AM	RICH 1532	TA#2	-----@uoguelph.ca
Thursday	8:30 AM - 10:20 AM	RICH 1532	TA#3	-----@uoguelph.ca
Friday	9:30 AM - 11:20 AM	RICH 1532	TA#4	-----@uoguelph.ca

## Instructor Information

### Shawki Areibi

Email: sareibi@uoguelph.ca

### Haleh Vahedi

Email: hvahedi@uoguelph.ca

## Additional Support

Teaching Assistant	Office	Email	Office Hours
TA#1	THRN 1425	xxxx@uoguelph.ca	Mon, 1:00 - 2:00 PM
TA#2	THRN 1425	xxxx@uoguelph.ca	Tue, 1:00 - 2:00 PM
TA#3	THRN 1425	xxxx@uoguelph.ca	Wed, 1:00 - 2:00 PM
TA#4	THRN 1425	xxxx@uoguelph.ca	Thu, 1:00 - 2:00 PM
TA#5	THRN 1425	dara@uoguelph.ca	Fri, 1:00 - 2:00 PM

## Textbooks

Group	Title	Author	ISBN
Required	Logic And Computer Design Fundamentals, forth Edition	M. Morris Mano, Pearson, 2014	
Recommended	VHDL for Engineers	K. Short, 2nd Edition, Prentice Hall, 2008.	

## Learning Resources

### Required Resources

CourseLink (<https://courselink.uoguelph.ca/shared/login/login.html>): Course material, news, announcements, and grades will be regularly posted to the F23 v1.00 ENGG\*2410 CourseLink. You are responsible for checking the site regularly.

### Additional Resources

VHDL Tutorial by Shawki Areibi (Article)

**Lecture Information (Notes):** All the lecture notes will be posted on CourseLink

**Lab Information (Notes):** The handouts for all the lab sessions will be posted on CourseLink.

**Assignments (Other):** The assignments will be posted on CourseLink.

**Miscellaneous Information (Other):** Other information related to Digital Design are also posted on the web page.

### Campus Resources

If you are concerned about any aspect of your academic program: Make an appointment with a Program Counsellor (<https://www.uoguelph.ca/uaic/programcounsellors/>) in your degree program. If you are struggling to succeed academically: There are numerous academic resources offered by the

Learning Commons (<https://www.lib.uoguelph.ca/using-library/spaces/learning-commons/>) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

## Course Learning Outcomes

1. Understand basic digital concepts and combinational digital logic.
2. Design and Analysis of basic/advanced combinational digital circuits.
3. Design and Analysis of basic/advanced sequential digital circuits.
4. Implement Finite State Machines and designing control units.
5. Ability to build combinational logic circuits out of standard TTL/CMOS parts.
6. Ability to use FPGAs and modern CAD tools for logic design.

## Teaching and Learning Activities

### Lecture Topics

Topics	References
Introduction to Digital Systems	Chapter 1
Combinational Logic Circuits	Chapter 2
Combinational Logic Analysis	Chapter 3
Combinational Logic Design (VHDL)	Chapters 3, 4
Arithmetic Circuits (VHDL)	Chapter 4
Basic Sequential Circuits (Analysis)	Chapter 5
Sequential Circuit Design (VHDL)	Chapter 5
Registers and Counters (VHDL)	Chapter 7
RTL Register Transfer and Data Path	Chapter 7
Design of Control Units and ASMs	Chapter 7
Memory (SRAM, DRAM)	Chapter 8
Programmable Logic Devices	Chapter 10

### Lab Activities

Week	Topics	Duration	Report	Due
Week 1	Intro to Lab Equipment and Safety Training	-	None	-
Week 2	Tutorial, Xilinx CAD Flow, Schematic Capture	2 Weeks	Yes	Week #4 in Drop Box
Week 4	Combinational Logic Design (Trip Genie), Schematic Capture	2 Weeks	Yes	Week #6 in Drop Box
Week 6	Tutorial, Xilinx CAD Flow, VHDL	1 Week	Yes	Week #7 in Drop Box
Week 7	Design of Decoders and 7-Segment Display	1 Week	Yes	Week #8 in Drop Box
Week 8	Arithmetic Circuits "Adder/Subtractor", VHDL	1 Week	Yes	Week #9 in Drop Box
Week 9	Sequential Logic Design (Sequence Recognizer), VHDL	1 Week	Yes	Week #10 in Drop Box
Week 10	Data Path Design (Arithmetic Logic Units), VHDL	2 Weeks	Yes	Week 12 in Drop Box

## Assessment Breakdown

Name	Scheme A (%)
Assignments	5%
Labs	15%
Midterm	30%
Final Exam	50%
<b>Total</b>	<b>100</b>

## Assessment Details

### Assignment

#### Assignments

**5%**

There will be 10 assignments throughout the term. Solve all problems and hand in your assignment to the teaching assistant in the tutorial.

Course Learning Outcomes Assessed: 1, 2, 4

### Lab Activities

#### Labs

**15%**

There will be 7 labs throughout the term.

Course Learning Outcomes Assessed: 1, 2, 4, 5, 6

### Midterm

#### Midterm Exam

**30%**

Date: Saturday (Week 7)

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5, 6

### Exam

#### Final Exam

**50%**

Day & Time: See Final Exam section below

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5

## Grading Schemes

### Passing Grade

The **passing grade in this course is 50%**. Students must obtain a grade of 45% or higher on the exam portion of the course in order for the laboratory write-up portion of the course to count towards the final grade.

### Lab Work

You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab.

## Last Day to Drop Course

The final day to drop Fall 2024 courses without academic penalty is the last day of classes: November 29

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

## Course Grading Policies

### Missed Assessment

If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration (<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>):

### Missed midterm/quiz tests

**Accommodation of Religious Obligations:** If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

**Missed midterm exam:** If the midterm is missed due to grounds for granting academic consideration, the weight of the missed midterm will be added to the final exam.

### Late Lab Reports

Late submissions of lab reports will be penalized unless you have good reasons. Explain to your teaching assistant the circumstances of why your lab report is submitted late.

## School of Engineering Statements

### Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on

Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

### Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

### Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible

## Standard Statements for Undergraduate Courses

### Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/>) is outlined in the Undergraduate Calendar.

### Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability. Use of the SAS Exam Centre requires students to make a booking at least 10 days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (<https://www.uoguelph.ca/sas/>)

## Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodations of Religious Obligations (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-accommodation-religious-obligations/>).

## Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

## Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all undergraduate students except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in the Undergraduate Calendar - Dropping Courses (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/dropping-courses/>).

## Email Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

## Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (<https://wellness.uoguelph.ca/>). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (<https://wellness.uoguelph.ca/navigators/>) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources (<https://wellness.uoguelph.ca/shine-this-year/>). The Student Wellness team are here to help and welcome the opportunity to connect with you.

## Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

## Recording of Materials

Presentations that are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## Resources

The Academic Calendars (<http://www.uoguelph.ca/registrar/calendars/?index>) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

## When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Undergraduate Calendar for information on regulations and procedures for Academic Consideration. (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/>)

## Professional Accreditation Outcomes

*Engineers Canada - Graduate Attributes (2018)*

Successfully completing this course will contribute to the following:

### 1. Knowledge Base

	<b>Graduate Attribute Indicator</b>	<b>Instructional Level</b>	<b>Data Collection for Accreditation</b>
1.3	Recall, describe and apply fundamental engineering principles and concepts	Introduced	Yes
1.4	Recall, describe and apply program-specific engineering principles and concepts	Introduced	Yes

### 2. Problem Analysis

	<b>Graduate Attribute Indicator</b>	<b>Instructional Level</b>	<b>Data Collection for Accreditation</b>
2.2	Identify, organize and justify appropriate information, including assumptions	Introduced	Yes

### 4. Design

	<b>Graduate Attribute Indicator</b>	<b>Instructional Level</b>	<b>Data Collection for Accreditation</b>
4.1	Describe design process used to develop design solution	Introduced	No
4.2	Construct design-specific problem statements including the definition of criteria and constraints	Introduced	No

### 6. Individual & Teamwork

	<b>Graduate Attribute Indicator</b>	<b>Instructional Level</b>	<b>Data Collection for Accreditation</b>
6.2	Understand all members' roles and responsibilities within a team	Introduced	No