

## **Course Description:**

Digital technology, combinatorial logic, binary arithmetic, sequential circuits, digital design, and microcontrollers. Topics will be reinforced in the context of biomedical microcontrollers and sensors used in physiological monitoring and clinical support systems.

*Prereq: Level at least 3A Biomedical Engineering. Antireq: BME 292, SYDE 192*

## **Intended Learning Outcomes:**

1. Analyze internal components of digital systems and their technical details
2. Explain the importance of digital systems and computer architecture for biomedical applications
3. Identify design possibilities offered by digital systems
4. Use biomedical controllers and sensors to design digital systems
5. Design digital systems that are reliable (observed behavior matches specifications), safe (avoid putting human lives in danger even in presence of errors and failures), and robust (ability to handle unspecified inputs and state)

## **CEAB Graduate Attributes:**

The numbers in parentheses included as part of the intended learning outcomes refer to the Engineering Graduate Attributes defined by the Canadian Engineering Accreditation Board (CEAB); these are listed below as reference:

<b>GA#</b>	<b>GA</b>	<b>Attribute Definition</b>	<b>PI</b>	<b>Program-Level Indicator ("BME graduates from UWaterloo should be able to...")</b>
<b>1</b>	<b>Knowledge Base</b>	Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.	1a	<b>Demonstrate understanding</b> of concepts in mathematics
			1b	<b>Demonstrate understanding</b> of concepts in natural science
			1c	<b>Demonstrate understanding</b> of engineering fundamentals
			1d	<b>Demonstrate understanding</b> of specialized engineering knowledge
<b>2</b>	<b>Problem Analysis</b>	An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.	2a	<b>Formulate</b> a problem statement
			2b	<b>Develop models</b> to solve engineering problems including identifying approximations, assumptions, and constraints
			2c	<b>Critically evaluate</b> solutions of engineering problems
<b>4</b>	<b>Design</b>	An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.	4a	<b>Identify</b> needs, design requirements, constraints, and specifications for complex, open-ended engineering problems
			4b	<b>Generate</b> and <b>refine</b> potential solutions to complex, open-ended design problems, considering safety, ethics, and applicable standards and regulations.
			4c	<b>Critically evaluate</b> and compare design choices
<b>5</b>	<b>Use of Engineering Tools</b>	An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.	5a	<b>Select</b> appropriate engineering tools, considering their limitations
			5b	<b>Create</b> and/or <b>modify</b> appropriate engineering tools, identifying their limitations
			5c	<b>Use</b> engineering tools appropriately

**Course Instructor:**

**Dr. Parsin Haji Reza**

Email: phajireza@uwaterloo.ca | Office: E7-6416

Office hours: open door (Zoom) policy (everyday 10am-5pm)

**To schedule a quick meeting with me:**

- 1- Please go to: <https://www.photomedicinelabs.com/schedule-a-meeting.html>
- 2- You can alternatively email my assistant to schedule a meeting as soon as possible:  
Stephanie Clarke: [photomedicinelabs@uwaterloo.ca](mailto:photomedicinelabs@uwaterloo.ca)

**Course TA:****1- James Tweel**

Email address: james.tweel@uwaterloo.ca

**2- Mohamed Abdelrahman**

Email address: mam5abde@uwaterloo.ca

*The office hours will be announced on LEARN.*

**Lecture Attendance:**

You are highly encouraged to attend all lectures and keep detailed class notes.

**Course Information on LEARN: <https://learn.uwaterloo.ca/>**

Regularly check the course web site on LEARN for announcements and deadlines.

**Required Reading:**

- ✓ Harris and Harris: "Digital Design and Computer Architecture." 2nd Edition, Morgan Kaufmann, 2012, ISBN 0123944244.

**Additional Reading:**

- ✓ Frank Vahid digital design Wiley publishers 2nd edition, ISBN: 978-0-470-53108-2 March 2010
- ✓ Mano and Ciletti: "Digital Design with an introduction to the Verilog HDL, VHDL, and system Verilog." 6th Edition, Morgan Kaufmann, 2018, ISBN 978-0-13-454989-7.
- ✓ David A. Patterson (Author), John L. Hennessy, Computer Organization and Design MIPS Edition: The Hardware/Software Interface, ISBN-13: 978-0124077263
- ✓ "Arduino Microcontroller Processing for Everyone!" by S. F. Barrett, which is available via UWaterloo library. This book is a part of Synthesis Lectures on Digital Circuits and Systems.  
<https://www.morganclaypool.com/doi/pdf/10.2200/S00522ED1V01Y201307DCS043>

**Grading Scheme for BME 393:**

- |  |                              |
|--|------------------------------|
| <input type="checkbox"/> In-Class Presentation 10% | (research + presentation)    |
| <input type="checkbox"/> Research Reports 10%      | (research + report)          |
| <input type="checkbox"/> Assignments 20%           | (based on problem scenarios) |
| <input type="checkbox"/> Midterm Exam 20%          | (After the break)            |
| <input type="checkbox"/> Final Exam 40%            | (scheduled by the Registrar) |

All students are expected to work individually and submit their own original work. Under Policy 71, the instructor may have follow-up conversations with individual students to ensure that the work submitted was completed on their own. Any follow up will be conducted remotely (e.g., MS

Teams, Skype, phone), as the University of Waterloo has suspended all in-person meetings until further notice.

**Exam Policy:**

A missed midterm exam will receive a mark of 0, unless there is a valid documented reason. If a documented reason is provided for missing the midterm, its weight is applied to the final exam. If a student is unable to write the final exam, they need to notify the instructor at least 24 hours before the exam.

**Graded Material and Feedback Delivery:**

Graded material will be returned to students in class or via LEARN, as appropriate.

**Assignments:**

There will be at least two-course assignments. Assignments will give you a chance to apply techniques learned in class to application case studies. The assignments will be due throughout the term. A missed assignment will receive a mark of 0, unless there is a valid documented reason. If a documented reason is provided for absence, the assignment weight is applied to other assignments. Only one assignment may be excused for the term.

**Remarking Requests:**

Attach a note to your graded deliverable clearly stating the parts that you want to be remarked. Include any supporting evidence for your case. No more than one week after the graded item is handed back, return the item with the remarking page attached to your instructor via email, in class, or during office hours.

**Absence Due to Special Circumstances or Illness:**

Let the instructor know in advance if you need to be away due to special circumstances. If the event conflicts with scheduled activities, then verification of the reason for absence is needed. In the event of illness that prevents attendance or participation in mandatory course activities, a Health Services Verification of Illness form must be completed by an authorized medical practitioner. For more information, consult the Health Services website, <http://uwaterloo.ca/health-services/student-medical-clinic/services/verification-illness>.

**In-Class Discipline:**

Students are encouraged to attend all lectures but are required not to be disruptive during lectures, out of respect for their classmates and for the instructor. Please make sure no inappropriate comments will be shared during the lectures. Also, note that comments and feedback about the course are welcome, but outside of lecture time. A student who is found to be disruptive during lectures will be given only one verbal warning for the term. At the instructor's discretion, if the same student continues to be disruptive, for each incident of disruption, they will be penalized 5% of their final mark for the course and will be asked to leave the lecture during which the disruption incident occurred. They would also be liable for any missed milestones during the lecture.

**Plagiarism Software:**

Turnitin.com and alternatives: Plagiarism detection software) will be used to screen some of the works in this course. This software is being used to verify that the use of all information and

sources is documented. A student may request not to have their assignments screened by Turnitin. If requested, in the first week of the term, details will be provided about the arrangements for the use of Turnitin and alternatives in this course.

**Academic Integrity:**

In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect, and responsibility. Check the Office of Academic Integrity's website for more information, <http://uwaterloo.ca/academic-integrity/>.

All members of the UW community are expected to hold to the highest standard of academic integrity in their studies, teaching, and research. This site explains why academic integrity is important and how students can avoid academic misconduct. It also identifies resources available on campus for students and faculty to help achieve academic integrity in — and out — of the classroom.

**Grievance:**

A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, <http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm>. When in doubt, please be sure to contact the department's administrative assistant who will provide further assistance.

**Academic Discipline:**

A student is expected to know what constitutes academic integrity (see link above) to avoid committing an academic offence, and to take responsibility for their actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (for example: plagiarism, cheating) or about expectations for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. Relevant documents include:

- University of Waterloo Policy 71 [Policy 71 Student Discipline].
- Academic Penalty Guidelines [Link Policy 71 Penalty Guidelines].
- Assessment of Unauthorized Collaboration: [Link Assessment of Unauthorized Collaboration].

**Appeals:**

A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals, <http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm>.

**AccessAbility Services:**

AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations

to lessen the impact of your disability, please register with them at the beginning of each academic term.

**Compassionate Accommodation:** If you are facing challenges that are affecting more than one course contact the Associate Chair Undergraduate (A.C.U.G. email: sydeunde@uwaterloo.ca) or the Director of BME (email: sdbmedir@uwaterloo.ca). They will review your case and coordinate a reasonable and fair plan in consultation with appropriate others (for example: instructors, Department Undergraduate Studies Committee, Chair, AccessAbility Services, Engineering Counselling services, Registrar's Office).

**Guiding Principles for our SYDE-BME Community (faculty, staff, and students):**

*1) Be compassionate. 2) Be accountable. 3) Be patient. 4) Be safe and healthy.*

**Compassionate and respectful communication:** Most online communication between the Department and students will be done through LEARN and/or email. Students are reminded that they should now use their email account name@uwaterloo.ca. Include an academic signature with your full name, program, student ID. We encourage you to include your preferred pronouns (he/him; she/her; they/them).

**SYDE-BME COMMENT ON ACCOMMODATION:** We respect that our SYDE-BME students are independent adult decision-makers, with many opportunities to partake in activities that might be in time conflict with academic deadlines and deliverables. Along with the right to make adult decisions comes the responsibility and accountability for those decisions and any outcomes.

The University of Waterloo's policy on accommodation for missed deliverables pertains to verifiable health matters, and highly unfortunate events (for example: family tragedies). The Department of Systems Design Engineering follows University of Waterloo's general policy: students who self-elect to forgo a deliverable receive a "0" for that deliverable. It is preferred practice so that fairness is maintained for members of the same class/course by avoiding preferential treatment, and so that instructors are not burdened with having to create extra quizzes, deliverables, etc. It also reflects professional practice, as failing to show up to work and missing deadlines can be very costly to the company and individual (for example: not submitting a contract proposal, or design review on time). *Please read the policy here: [[Accommodation due to illness](#)]*