

BME 393 – Digital Systems

Course Outline

Winter 2025

Instructor Email	Dr. Omar Al-Buraiki omar.alburaiki@uwaterloo.ca OH: Fri 12:00-1:30pm; @ GI -1332B
Lectures	Tu, Th: 11:00am -12:20pm
TAs:	1. Ahmed Fahim, Email: ahmedfahim@uwaterloo.ca ; OH: TBD 2. Andrei Paredes, Email: af2perez@uwaterloo.ca ; OH: TBD 3. Howard Nguyen-Huu, Email: howard.nguyen-huu@uwaterloo.ca ; OH: TBD
Lab Instructor	Orion Bruckman orion.bruckman@uwaterloo.ca
Tutorials	We 1:30-02:20pm
Grading Scheme	Midterm Exam (30%), Final Exam (45%), Design Project (15%), Assignments (10%).
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. <i>Prereq:</i> Level at least 3A Biomedical Engineering. <i>Antireq:</i> BME 292, SYDE 192.
Course Objectives	At the end of the course, the student is aimed to be able to: 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. Apply digital systems principles to the design of biomedical controllers and sensors. 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)
Course Contents: (Subject to change)	<ul style="list-style-type: none">• Introduction, Computer Architecture, Digital Abstraction• Combinational Logic and Combinational Circuits• More on Combinational Logic and Combinational Circuits• Arithmetic Circuitry and Arithmetic Logic Unit (ALU)• More on Arithmetic Circuitry and Arithmetic Logic Unit (ALU)• Sequential Circuits and Sequential Logic Design• More on Sequential Circuits and Sequential Logic Design• Microcontroller Architecture and Interfacing, Timers/Counters• Interrupts, Communication Protocols, Applications of Microcontrollers• Microprocessor Architecture, Datapath Design• Microprocessor Control Unit, Assembly Language• Microprocessor Pipelined Design• More on Microprocessor Pipelined Design
Textbook (Required)	Harris and Harris: “Digital Design and Computer Architecture”. 2 nd Edition, Morgan Kaufmann, 2012, ISBN 0123944244.

Optional Readings

- Patterson and Hennessy, "Computer Organization and Design". 5th Edition, Morgan Kaufmann, 2013, ISBN 0124077269.
 - Brown and Vranesic, "Fundamentals of Digital Logic with VHDL Design". 3rd Edition, McGraw-Hill Education, 2008, ISBN 0077221435.
 - Vahid, "Digital Design with RTL Design, VHDL, and Verilog". 2nd Edition, Wiley, 2010, ISBN 0470531088.
 - Steven F. Barrett "Arduino Microcontroller Processing for Everyone!", available via UWaterloo library. This book is a part of Synthesis Lectures on Digital Circuits and Systems.
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Academic Integrity Rules and Your Rights Tentative: Policy on Cheating: Engineering, medicine and law are professions. The word profession means that the members serve the public and must practice with the highest standard of honesty and ethics. Without these standards, buildings, hospitals and courts would be unsafe for the general public. A profession policy itself: that is, disciplinary action is taken against its own members for violations even if the instance is not illegal. (Legal action may also be taken if laws have been broken.) Plagiarism, or stealing of intellectual property, is a violation of ethics and arguably the law. At the University of Waterloo Policy 71 governs plagiarism. Please read http://www.eng.uwaterloo.ca/~ugoffice/html/course_responsibilities.html regarding your responsibilities and rights.

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 www.uwaterloo.ca/academicintegrity/ for more information.]

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, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean.

For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

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) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm

AccessAbility Services: The AccessAbility Services Office, located in Needles Hall, Room 1132, 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 AccessAbility Services at the beginning of each academic term.

* For latest updates and news please frequently check the LEARN page of the course.