University of Manitoba | Price Faculty of Engineering
Department of Electrical and Computer Engineering

Course Outline

ECE 3760 – Digital Systems Design I

Winter 2024

Instructor

- Bob McLeod, P.Eng.
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- David Stewart
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Office Hours

- By appointment
  (basically anytime)

Contact Hours

- 4 credit hours
- Lectures:
  3 hours x 12 weeks = 36 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours

Prerequisites:

- ECE 4240 Microprocessor Interfacing

Course Objectives

As the use of embedded systems becomes more widespread, and their operation and inter-device interactions become more complex, it is important that a principled design methodology be followed in the development of such systems. The goal of this course is to provide a framework for the design of digital systems with specific emphasis on modeling, design tools and designing embedded applications.

Course Content

The following topics will be covered:

- The design process as it applies to digital systems with emphasis on empathic design;
- Development of a design from conception through to a functional prototype;
- Modeling of embedded systems;
- Examining system performance factors;
- Inter-component communication;
- Introduction to security with emphasis for embedded systems.
- Project specific topics on sensors and actuators as they arise.
- Also interspersed will be quest lectures covering topics ranging from empathic design, equity diversity and inclusion within team based design, intellectual property, productization, marketing a technological product, power management to advanced synchronization for real time embedded systems.

Laboratories

Laboratory work may be performed in groups of four students for collaboration and support, with each student performing their own work and with individual submissions of each lab. Each student is required to use a laboratory notebook/design journal in which to record information relevant to the conduct of the five laboratories and the umbrella design project that forms the basis of the laboratories.

Textbook (available as a free PDF)

Embedded Systems – Shape the World, J. Valvano and R. Yerraballi.
Available online at http://users.ece.utexas.edu/~valvano/Volume1/E-Book/

Reference (optional, also available as a free PDF)

Introduction to Embedded Systems: A Cyber-Physical Systems Approach, Edward Ashford Lee and Sanjit Arunkumar Seshia, MIT Press, 2016.

https://ptolemy.berkeley.edu/books/leeseshia/releases/LeeSeshia_DigitalV2_2.pdf

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Traditional Territories Acknowledgement

The University of Manitoba campuses and the Department of Electrical and Computer Engineering are located on original lands of the Anishinaabeg, Cree, Ojibwe-Cree, Dakota, and Dene peoples, and on the homeland of the Red River Métis.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of Reconciliation and collaboration.

Important Dates

- **Voluntary Withdrawal Deadline**
  March 20th, 2024
- **Louis Riel Day**
  February 19th, 2024
  No classes or examinations
- **Spring Break**
  February 20th – 23rd, 2024
  No classes or examinations
- **Good Friday**
  March 29th, 2024
  No classes or examinations

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 55%
- Engineering Design: 45%

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and team work
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/ environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

I - Introduced (Introductory)
D - Developed (Intermediate)
A - Applied (Advanced)

Learning Outcomes

1. Demonstrate the ability to formulate a system architecture composed of a microcontroller and supporting components.
2. Demonstrate the ability to design and develop basic embedded software for digital systems.
3. Demonstrate the ability to estimate system performance in relation to power use, and use this information to evaluate and improve a design.
4. Acquire a working understanding of common inter-component communication protocols for embedded applications.
5. Apply equity, accessibility, and intellectual property (IP) protection concepts in engineering design.
6. Apply and further develop team skills.

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	D	D	D	A	D							
2	A	D	D	A	D							
3	D	D	D		D							
4	D		D		D							
5			D	D			D	D	A	A	D	
6						A	A	A				A

CEAB Graduate Attributes Assessed

CS.1 – Designs and produces effective written and graphical engineering documents for specific audiences. (ex. research reports, engineering reports, design documents.)

EE.1 – Appreciates and articulates ethical considerations, and resolves ethical issues, related to engineering activities.

Evaluation

The final course grade is determined by the student's performance on assignments, in laboratories, and on tests and examinations.

Students must complete all laboratories in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Assignments	45	F, S	1, 5, 6
Project (includes laboratories)	25	F, S	1, 2, 3, 4, 5, 6
Final Examination	30	S	1, 2, 3, 4, 5

∗ Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)

Student Absences

Attendance in lectures, tutorials, and laboratories is mandatory. For short-term absences due to illness or other extenuating circumstances of 120 hours (5 days) or less, students are required to complete a *Self-Declaration Form for Brief or Temporary Absence* available on the University website.🔗 This form must be submitted to the course instructor within 48 hours of the absence. (No additional documentation is required.)
Note that students are responsible to complete any missed work and must consult with the instructor to make appropriate arrangements.
For absences longer than 120 hours, students must contact the instructor and ECE Undergraduate Advisor, Tammy Holowachuk (Tammy.Holowachuk@umanitoba.ca) for further instructions.

Grading Scale

Letter	Mark
A+	95–100
A	85–94
B+	80–84
B	70–79
C+	65–69
C	55–64
D	45–54
F	< 45

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Deferred Final Examinations

Students who miss the regular scheduled writing of a final examination, for valid medical or compassionate reasons, may be given the opportunity to write a deferred examination, subject to approval by the Associate Dean (Undergraduate). All requests for a deferred examination must be made within 48 hours of the missed examination, and must follow the procedure described on the Faculty website, without exception. Course instructors do not have the discretion to grant deferred final examinations. (https://umanitoba.ca/engineering/student-experience#engineering-student-policies)

Copyright Notice

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

Requirements/Regulations

- Virtual attendance at lectures and laboratories is recommended for successful completion of this course. Students must satisfy each evaluation component in the course to receive a passing final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Resources