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

Course Outline

ECE 3760 – Digital Systems Design I

Winter 2026

Instructors

- Bob McLeod, P.Eng.
  Robert.McLeod@umanitoba.ca
- David Stewart
  E3-416 EITC
  David.Stewart@umanitoba.ca

Office Hours

- By appointment
  (basically anytime)

Teaching Assistants

- Gokarna Baskota
  baskotag@myumanitoba.ca
- Graham Driver
  driverg@myumanitoba.ca
- Evan Tyerman
  tyermane@myumanitoba.ca

Contact Hours

- 4 credit hours
- Lectures: 3 hours per week
- Laboratories: 3 hours x 5 weeks

Prerequisites:

- ECE 4240 Microprocessor Interfacing

Traditional Territories Acknowledgement

The University of Manitoba campuses and research spaces are located on original lands of Anishinaabeg, Ininiwak, Anisininewuk, Dakota Oyate, Dene and Inuit, and on the National Homeland of the Red River Métis.

UM recognizes that the Treaties signed on these lands are a lifelong, enduring relationship, and we are dedicated to upholding their spirit and intent. We acknowledge the harms and mistakes of the past and the present. With this understanding, we commit to supporting Indigenous excellence through active Reconciliation, meaningful change, and the creation of an environment where everyone can thrive. Our collaboration with Indigenous communities is grounded in respect and reciprocity and this guides how we move forward as an institution.

Course Objectives

As embedded systems increasingly power real-world technologies—including those that advance accessibility—engineers must learn disciplined, reliable development practices. This course provides a structured framework for creating embedded systems, emphasizing behavioral modeling, effective use of development tools, and hands-on, iterative prototyping of electronic assemblies. Students will develop core skills in component selection, prototyping, and preparing designs for manufacturing, culminating in a set of functional wireless prototypes that target practical, accessibility-focused solutions.

Course Content

With an overall theme of the design process as it applies to embedded systems with an emphasis on empathic design, the following topics will be covered:

- Development of a design from conception through to a functional prototype.
- Modeling of embedded systems.
- Evaluating system performance factors - both quantitative and qualitative.
- Low power optimization of embedded systems.
- Development of basic 2-way communication protocols for multi-part systems.
- Basics of embedded system security.
- Fundamentals of PCB design.
- Project specific topics on sensors and actuators as they arise.
- A variety of guest lectures which may cover topics ranging from: Empathic design; equity, diversity, and inclusion; intellectual property; productization and marketing; value of failure; basics of 3D modelling/printing; and other selected topics as they related to design/embedded systems/manufacturing. (This list is not comprehensive and may change periodically)

Laboratories

Laboratory work may be performed in groups of two students for collaboration and support, with each student performing their own work and with individual submissions of each lab. Each student is required to maintain an ongoing a laboratory notebook/design journal in which they record information relevant to the conduct of each of the five laboratories and how they relate to their larger group design project that is due at the end of the term.

Textbook

No specific textbooks are required, but additional free educational resources may be provided from time to time in class or via UM Learn.

Reference (optional, also 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/

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

Important Dates

- **Voluntary Withdrawal Deadline**
  March 19th, 2026
- **Louis Riel Day**
  February 16th, 2026
  No classes or examinations
- **Spring Break**
  February 17th – 20th, 2026
  No classes or examinations
- **Good Friday**
  April 3rd, 2026
  No classes or examinations

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

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)

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 (includes design reviews)	40	F, S	1, 5, 6
Project (includes laboratories)	30	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)

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 set out within 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). This includes the unauthorized use of AI when preparing course deliverables. A student found guilty of contributing to cheating by another student is also subject to serious academic penalty. Integrity also applies to respecting copyrighted course content, which should not be distributed without the creator's permission. Uploading content for the purpose of transcription or other AI-enabled features is commonly a violation of the copyright holder's rights.

Copyright Notice

All materials provided in this course are copyright and are provided under the fair dealing provision of the *Canadian Copyright Act*. This material may not be redistributed in any manner without the express written permission of the relevant copyright holder. This includes recording class sessions for personal use and/or uploading any course materials to a website.

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 and Regulations

- Attendance at lectures and laboratories is essential 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 they are uncertain about their standing in the course and about their potential for receiving a failing grade. Students should also familiarize themselves with the University's *General Academic Regulations* 🔗, as well as the Price Faculty of Engineering *Academic Regulations* 🔗 dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, smart 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*