



Course Outline

Instructor

- Prof. Bob McLeod, P.Eng.
E1-548 EITC
(204) 474-8886
Robert.McLeod@umanitoba.ca

Office Hours

- By appointment
(basically anytime)

Teaching Assistant

- Ryan Dion
umdion@myumanitoba.ca

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 Website:

<http://umanitoba.ca/umlearn>

Important Dates

- **Term Test**
None
- **Voluntary Withdrawal Deadline**
March 31st, 2021
- **Louis Riel Day**
February 15th, 2021
No classes or examinations
- **Spring Break**
February 16th – 19th, 2021
No classes or examinations
- **Good Friday**
April 2nd, 2021
No classes or examinations

ECE 3760 – Digital Systems Design I

Winter 2021

IMPORTANT NOTICE – Mandatory Requirement to Report

This course will be conducted using remote instruction. Students who are accessing the course from outside of Canada or the USA **must notify the instructor** and indicate in which country they are located. Access to software may be restricted from some countries and failure to comply with these restrictions may result in criminal prosecution.

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.

Accreditation Details

Accreditation Units

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

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

- 1 - Knowledge (Able to recall information)
- 2 - Comprehension (Ability rephrase information)
- 3 - Application (Ability to apply knowledge in a new situation)
- 4 - Analysis (Able to break problem into its components and establish relationships.)
- 5 - Synthesis (Able to combine separate elements into a whole)
- 6 - Evaluation (Able to judge the worth of something)

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.

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	3	4	4	5	4							
2	5	4	4	5	4							
3	3	4	4		4							
4	3		4		4							
5			4	4			4	4	5	5	4	
6						5	5	5				5

CEAB Graduate Attributes Assessed

CS.2 – Designs and produces appropriate engineering documents (i.e. research reports, engineering reports, design documents, graphics)

EE.1 – Demonstrates and/or applies knowledge of ethical principles.

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)	30	F, S	1, 2, 3, 4, 5, 6
Final Examination	25	S	1, 2, 3, 4, 5

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

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.

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 Information](#)