



## Course Outline

### Instructor

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

### Office Hours

- Students may also drop by E3-416 between 9:00AM-5:00PM.

### Teaching Assistant

- David Stewart  
stewar43@myumanitoba.ca

### Contact Hours

- 4 credit hours
- Lectures:  
3 hours x 13 weeks = 39 hours
- Laboratories:  
3 hours x 5 weeks = 15 hours

### Prerequisites:

- ECE 4240 Microprocessor Interfacing

### Course Website:

<https://umanitoba.ca/umlearn>

## Traditional Territories Acknowledgement

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

*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.*

## ECE 4740 – Digital System Implementation

Fall 2022

### Course Objectives

Implementation methodologies and technologies for digital systems, including application specific integrated circuits (ASICs), system on chip (SoC) and rapid prototyping using Field Programmable Gate Arrays (FPGA). A good understanding of test techniques and improving reliability from a systems perspective is a concomitant objective.

### Course Content

The following topics will be covered:

- Integrated circuit overview
- Basic MOS transistor operation
- The CMOS inverter in detail as a building block
- CMOS-VLSI fabrication (minimal)
- Performance issues and basic transmission lines
- Basic circuits (minimal)
- Abstractions for simulation and modelling. (Elmore delay through to static timing analysis.)
- Regular structures (Embedded memory and flash)
- Integrated circuit faults and models
- Design for test (scan based design and built-in self-test.)
- Fault tolerant design

### Laboratories

The laboratories will focus on reliability of electronic components, sub-systems and systems, through both hardware and encoding technique simulations. Results will be achieved through building simulation models.

### Textbook

On-line notes and presentation materials.

### Other Resources

*Digital Design: A Systems Approach*, W.J. Dally, R.C. Harting, Cambridge University Press, 2012.

*Modelling, Synthesis and Rapid Prototyping with the Verilog HDL*, M.D. Ciletti, Prentice Hall, 1999.

*Fundamentals of Digital Logic with Verilog Design*, S. Brown and Z. Vranesic, McGraw-Hill 2014.

### 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.

### Learning Outcomes

1. Interpret and paraphrase the operation of MOS Transistors and the CMOS Inverter.
2. Design simple logic gates in a bottom up fashion.
3. Evaluate system design and design trade-offs as it pertains to chip level systems.
4. Construct reliability simulations of components and systems.

Important Dates		Expected Competency Levels												
		Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
• <b>Term Test</b> TBD		1	3	3	3	4	6							3
• <b>Voluntary Withdrawal Deadline</b> November 22 <sup>nd</sup> , 2022		2	4	4	3	3	6							3
• <b>National Day for Truth and Reconciliation</b> September 30 <sup>th</sup> , 2022 No classes or examinations		3	2	4	3	4	5							3
• <b>Thanksgiving Day</b> October 10 <sup>th</sup> , 2022 No classes or examinations		4	3	5	4	3	6							5
• <b>Remembrance Day</b> November 11 <sup>th</sup> , 2022 No classes or examinations														
• <b>Fall Term Break</b> November 7 <sup>th</sup> –10 <sup>th</sup> , 2022 No classes or examinations														
Evaluation														
The final course grade is determined by the student's performance on assignments, in laboratories, and on examinations. Students must complete a subset of the laboratories in order to be eligible to receive a passing grade.														
Accreditation Details		Table showing the distribution of assignments, laboratories, and examinations across learning outcomes (IE, EE, EP, LL).												
Accreditation Units		Component	Value (%)	Method of Feedback			Learning Outcomes Evaluated							
• Mathematics: 0%		Assignments	5	F, S			1, 2							
• Natural Science: 0%		Laboratories	35	F, S			3, 4							
• Complementary Studies: 0%		Term Test (Oral)	20	F, S			1, 2, 3							
• Engineering Science: 40%		Final Examination	40	S			1, 2, 3							

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

## CEAB Graduate Attributes Assessed

PA.4 – Evaluates a solution to a complex engineering problem.

ET.2 – Evaluates and selects appropriate tools for a given scenario.

## Student Absences

Attendance in lectures and laboratories is mandatory. For short-term absences due to illness or other extenuating circumstances of 72 hours 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 72 hours, students must contact the instructor and ECE Undergraduate Advisor, Tammy Holowachuk (Tammy.Holowachuk@umanitoba.ca) for further instructions.

## 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.

## 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.

## 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.

## Requirements and Regulations

- Attendance at lectures and laboratories is important for successful completion of this course. Students must satisfy each evaluation component in the course to receive a 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, 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](#)