



Course Outline

Instructor

- Prof. Witold Kinsner, P.Eng.
E3-415 EITC
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Office Hours

- MWF 1:20pm – 2:00pm or by appointment

Teaching Assistant

- Andrew Kozar
kozara@myumanitoba.ca
- Hongru Li
lih34527@myumanitoba.ca
- Vinhu Vu
vuv1@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 3610 Microprocessor Systems
- COMP 1012 Computer Programming for Scientists and Engineers

Course Website:

<http://umanitoba.ca/umlearn>

Important Dates

- **Term Test**
Wednesday, March 17th, 2021
6:00PM – 8:00PM
- **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 3730 – Principles of Embedded Systems Design 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

This course will introduce students to the design and implementation of embedded systems. Topics include introduction to UML and data structures, A2D, D2A, serial bus architectures (SPI and I²C), embedded computing, bus-based computer systems, program design and analysis, networks, and hardware-software co-design.

Course Content

The following topics will be covered:

- Embedded systems design process and principles
- Formalisms for system design
- Processors and/or FPGA based system implementation
- Inter-component communications
- Program design and analysis
- Data structures.

Textbook

Witold Kinsner and Ken Ferens, *Foundation of Embedded Systems Design: Lecture Slides*. Winnipeg, MB: University of Manitoba, Department of ECE, January 2017.

Other Resources

Jonathan W. Valvano, *Embedded Microcomputer Systems: Real Time Interfacing*. Stamford, CT: Cengage Learning, 2012 (3rd ed.), 793 pp. & CD-ROM. This book covers design methodologies with examples, using Motorola 6805, 6808, 6811 (no longer in the third edition), and focuses on the 9S12 machines. The book includes many practical examples. The CD-ROM includes a complete editor/assembler, and simulator for the MC9S12 machine. {ISBN 978-1-111-42625-2}

Alan Clements, *Microprocessor Systems Design: 68000 Hardware, Software, and Interfacing*. Boston, MA: PWS Computer Science, 1998 (3rd ed.), 978 pp & CD-ROM. In addition to the material covered in the second edition (the 68000; memories; exception handling; serial I/O; buses, designing systems), this third edition includes a chapter on the C programming and its relationship to assembly language, as well as new examples and applications, better representation of timing diagrams, and a CD-ROM with a 68000 cross-assembler and simulator for DOS and Windows, and a cross compiler for C. {QA76.8.M67C48 1997; ISBN 0-534-9482-7}.

Learning Outcomes

1. Demonstrate the ability to model the design of an embedded system using UML diagrams.
2. Demonstrate the ability to use the C language to write programs for embedded systems.
3. Demonstrate the ability to apply C linked-list, pointer, and data structures in embedded applications.
4. Demonstrate the ability to apply COTS components (A2D, D2A, configurable real-time clock, rotary encoder, LCD, GPIO expander, and FIFO memory) in the design of various embedded systems applications (device tuner, arbitrary waveform generator, signal filter, error detection and correction, and LCD display system).
5. Apply the SPI and I²C inter-component communications protocols in embedded systems.

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 60%
- Engineering Design: 40%

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.

Expected Competency Levels

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

CEAB Graduate Attributes Assessed

- KB.4 – Recalls and defines, and/or comprehends and applies, first principles and concepts in specialized engineering science.
- DE.3 – Develops/implements possible solutions to an open-ended design problem, leading to an appropriate recommendation.

Evaluation

Students must satisfy each evaluation component in the course to receive a final grade. This means that students must complete and pass all laboratories, projects, and examinations to be eligible to receive a passing grade. The final course grade is determined by the student's performance in the following:

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Projects: Laboratories and Assignments	40	F, S	1, 2, 3, 4, 5
Term Test	20	F, S	2, 3, 4, 5
Final Examination	40	S	1, 2, 3, 4, 5

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

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.

Requirements/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 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.

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.