Course Outline

ECE 3740 – Systems Engineering Principles 1

Fall 2026

Instructor

- Ken Ferens, P.Eng.
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Office Hours

- By appointment

Teaching Assistant

- Rodrigo Alegria
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- Md Akhlaq Rifat Rahman
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Contact Hours

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

Prerequisites:

- COMP 2140 Data Structures and Algorithms

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

This course teaches systematic approaches to the design and development of large and complex computer based systems. The systematic approaches include hardware and software architecture and architectural elements; design patterns; object oriented design, analysis, and synthesis; and hardware and software engineering. This course uses the project based learning and hands-on experiential learning method to develop design thinking, critical problem solving, communication, and teamwork skills. Students will work throughout the course individually and in coordinated teams on designing hardware and software for solving an authentic real world computer engineering problem. Students are evaluated by their demonstration of the specified CEAB attributes and performance in the hands-on sub-projects, midterm test, and final exam.

Course Content

The following topics will be covered:

- Principles of object orientation: class/object, information hiding, polymorphism, inheritance/interface
- Principles of object oriented analysis: modeling, domain analysis, requirements engineering, problem breakdown and analysis
- Principles of object oriented synthesis: divide and conquer, minimizing complexity, maximizing cohesion, architectural patterns, design patterns, designing for reuse, and reusing designs
- Java and C programming languages for software descriptions
- Modeling: Unified Modeling Language (UML) and XML
- Debugging, verification, and validation
- Use of TCP/IP Stack software and associated tools
- Test Plan and Procedures (unit and system tests) and design documentation.

Projects

- Client-Server architecture and socket design
- Developing TCP/UDP client-servers across different platforms
- Console and Graphical User Interface (GUI) design
- Interfacing with sensors for environmental monitoring and control using PMODs
- Service oriented architecture application, design and integration

Textbook

Course notes available online.

Other Resources

Object-oriented Software Engineering: Practical Software Development Using UML and Java T. C. Lethbridge and R. Laganiere, 2nd edition, McGraw Hill, 2001. ISBN 0-07-710908-2

The Java Tutorials, http://java.sun.com/docs/books/tutorial/index.html.

Unified Modeling Language User Guide, G. Booch, J. Rumbaugh and I. Jacobson

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Important Dates

- **Term Test**
  October 21st, 2026
  6:00PM – 8:00PM
- **Voluntary Withdrawal Deadline**
  November 24th, 2026
- **National Day for Truth and Reconciliation**
  September 30th, 2026
  No classes or examinations
- **Thanksgiving Day**
  October 12th, 2026
  No classes or examinations
- **Remembrance Day**
  November 11th, 2026
  No classes or examinations
- **Fall Term Break**
  November 9th –13th, 2026
  No classes or examinations

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 50%
- Engineering Design: 50%

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. Identify the importance of applying systems engineering principles to design of large and complex systems.
2. Perform requirements engineering for large and complex software design.
3. Model the designs of large and complex systems using UML.
4. Apply the main object oriented principles to the design of large and complex embedded systems.
5. Demonstrate the ability to use an integrated development environment to develop embedded applications on host computers, servers, and microcontrollers.
6. Construct formal test cases and test plans.
7. Write design documentation.

Expected Competency Levels

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

Evaluation

The final course grade will be determined from a student's performance in the projects and on examinations. In order to receive a passing grade in this course:

- All projects must be completed and a passing grade must be achieved.
- A passing grade in the final exam must be achieved.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Projects, Assignments, Laboratories	25	F, S	1, 2, 3, 4, 5, 6, 7
Term Test	25	F, S	2, 3, 4, 5, 6
Final Examination	50	S	1, 2, 3, 4, 5, 6, 7

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

CEAB Graduate Attributes Assessed

DE.1 – Understands the complexities of an open-ended engineering design problem and defines appropriate objectives and constraints.

ET.1C – Uses hands-on tools to complete engineering activities.

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 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). 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.

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 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