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

Course Outline

Instructor

- Prof. Elham Salimi, P.Eng.
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Office Hours

- Tuesday, 11:30AM–12:00PM,
  Wednesday, 2:30PM–3:00PM,
  Thursday, 11:30AM–12:00PM,
  or by appointment

Teaching Assistants

- Fatiah Balogun
  balogun8@myumanitoba.ca
- Dulja Bamunusinghe
  bamunusd@myumanitoba.ca
- Saman Dehghan
  dehghan1@myumanitoba.ca

Contact Hours

- 4 credit hours
- Lectures:
  3 hours x 13 weeks = 39 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours
- Tutorials (compulsory):
  1 hour x 12 weeks = 12 hours

Prerequisites:

- ECE 2240 Numerical Methods for Electrical Engineers
- PHYS 2152 Modern Physics for Engineers
- MATH 3132 Engineering Mathematical Analysis

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.

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 3580 – Foundations of Electromagnetics

Fall 2025

Course Objectives

This course covers the fundamentals of electromagnetic field theory. It begins with electrostatics and magnetostatics, where students learn the theoretical foundations to calculate electric and magnetic fields and understand related topics such as polarization, magnetization, boundary conditions, and the concepts of energy and force. The latter part of the course focuses on time-varying electromagnetic fields and Maxwell's equations, with an emphasis on Faraday's law of electromagnetic induction and displacement current density. Laboratory sessions complement the theoretical material, utilizing numerical simulations in COMSOL Multiphysics and programming in MATLAB.

Course Content

The following topics will be covered:

- Electrostatics
  - Coulomb's law, electric force, the electric field
  - Gauss's law, electric potential, conductors in a static electric field
  - Solving boundary value problems, boundary conditions
  - Dielectrics in a static electric field, electric flux density, polarization vector, capacitance
  - Electrostatic energy and forces
- Magnetostatics
  - Biot-Savart law, magnetic force, the magnetic field
  - Ampère's circuital law, vector magnetic potential
  - Magnetization, magnetic field intensity, relative permeability, magnetic circuits
  - Boundary conditions, self and mutual inductance
  - Energy in magnetostatic systems, forces and torques
- Electromagnetic Fields
  - Introduction to Maxwell's equations and time-varying electromagnetic fields
  - Faraday's law of electromagnetic induction
  - Displacement current density

Textbook (Optional)

Fundamentals of Applied Electromagnetics, F.T. Ulaby and U. Ravaioli, 7th edition, Pearson, 2015, ISBN: 0-133-35681-7.

Other References

Field and Wave Electromagnetics, D.K. Cheng, 2nd edition, Addison-Wesley, 1989, ISBN: 0-201-12819-5.

Learning Outcomes

1. Acquire an understanding of Electrostatics Laws with ability to apply them to determine electric fields, electric potentials, capacitance, energy and forces in various electrostatic systems.
2. Acquire an understanding of Magnetostatics Laws with ability to apply them to determine magnetic fields, magnetic vector potentials, self and mutual inductance, energy and forces in various magnetostatic systems.
3. Acquire an understanding of classical Electromagnetic Field Theory via Maxwell's Equations with the ability to determine induced voltage using Faraday's law of electromagnetic induction, and to calculate time-varying electric field due to a time-varying magnetic field (and, vice versa) in free space.

Important Dates

- **Term Test**
  October 16th, 2025
  6:00PM – 8:00PM
  November 20th, 2025
  6:00PM – 8:00PM
- **Voluntary Withdrawal Deadline**
  November 18th, 2025
- **National Day for Truth and Reconciliation**
  September 30th, 2025
  No classes or examinations
- **Thanksgiving Day**
  October 13th, 2025
  No classes or examinations
- **Remembrance Day**
  November 11th, 2025
  No classes or examinations
- **Fall Term Break**
  November 10th –14th, 2025
  No classes or examinations

Accreditation Details

Accreditation Units

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

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)

Expected Competency Levels

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

Evaluation

Students must receive a minimum of 50% on the final examination in order to be eligible to receive a passing grade. Students who are unable to write the mid-term exam for medical (or other acceptable) reasons will have their final examination weighted to include the mid-term weighting. Students must complete all the laboratories in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Laboratories	15	F, S	1, 2, 3
Quizzes (best 3 of 4)	10	F, S	1, 2, 3
Term Tests	35	F, S	1, 2
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

KB.3 – Recalls and defines, and/or comprehends and applies information, first principles, and concept in fundamental engineering science.

PA.2 – Develops and/or implements a strategy to analyze complex engineering problems.

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.

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)

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.

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.

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.

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*

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.