



## ECE221H1S: ELECTRIC AND MAGNETIC FIELDS

**COURSE DESCRIPTION:** The fundamental laws of electromagnetics are covered, including Coulomb's law, Gauss' law, Poisson's and Laplace's equations, the Biot-Savart law, Ampere's law, Faraday's law, and Maxwell's equations. Vector calculus is applied to determine the relationship between the electric and magnetic fields and their sources (charges and currents). The interaction of the fields with material media will be discussed, including resistance, polarization in dielectrics, magnetization in magnetic materials, properties of magnetic materials and boundary conditions. Other topics include: electric and magnetic forces, the electric potential, capacitance and inductance, electric and magnetic energy, magnetic circuits, and boundary-value problems.

**COURSE OBJECTIVES:** Electric and magnetic fields are not only involved in many physical phenomena (strength of materials, bio-electricity, lightning etc.), but they are also underpinning current and emerging technologies such as wireless / wireline communications, radio-frequency identification (RFID) systems, magnetic levitation, magnetic resonance imaging (MRI), wireless power transfer (and the related concept of wireless batteries), near-field communications (NFC) and micro-electromechanical systems (MEMS). This course is aimed at providing students with the ability to understand the fundamentals of electricity and magnetism and their relation to some of their most exciting current applications.

### INSTRUCTORS

Lecture Section	Name	Office	E-mail
L01, L02	Prof. Reza Iravani	SF1021D	iravani@ecf.utoronto.ca
L03	Prof. Sean V. Hum <sup>1</sup>	BA5122	sean.hum@utoronto.ca

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<sup>1</sup>Course coordinator

### MARK COMPOSITION

Term test 1 (Thursday, Feb. 25) <sup>2</sup>	20% <sup>3</sup>
Term test 2 (Thursday, Mar. 25) <sup>2</sup>	20% <sup>3</sup>
Laboratories	20%
Final assessment <sup>2</sup>	40%

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<sup>2</sup>**Open book**, with only **non-programmable calculators** (Type 2) allowed. A set of aid sheets will be provided, and will be made available in advance on Quercus (exam type B).

<sup>3</sup>No make-up tests will be conducted. Petitioned tests will have their marks transferred to the final assessment.

## REFERENCE MATERIALS

1. Fawwaz T. Ulaby, Umberto Ravaioli, Fundamentals of Applied Electromagnetics, 8th Ed., Pearson Education, 2020, ISBN 9780135739433 (**required**)

The U of T bookstore has an e-book version available for purchase, ISBN 9780135199008.

2. Randall D. Knight, Physics for Scientists and Engineers Workbook Volume 4 (chapters 25–36), 3rd ed., Reading, MA: Addison-Wesley, 2013 (optional)

## COURSE WEBSITE

The course website is accessible through Quercus:

<https://q.utoronto.ca>

You should have access to ECE221H1S: Electric and Magnetic Fields listed. Please note that we have merged the sites for all lecture sections (look for: **ECE221H1S: LEC0101**). All of the communication and handouts will be found under this heading, except for labs. You will also have access to heading for only your lecture section, which will not be used.

## PROBLEM SETS

Each week, a set of suggested problems will be posted on the course website. The problems will deal with material covered in the lectures that week. You are strongly encouraged to complete all of the problem set questions. This course aims to build proficiency in problem-solving, and you cannot develop this without practice! If you complete the problem sets, you will greatly improve your chances of doing well in the course assessments.

## COMPUTER LABS

This course has a computer lab component that consists of six experiments, beginning the second week of class. Labs consist of completing a graded quiz of concepts at the beginning of the class, working through a computer module, and answering questions about the module and quiz to the TAs at the end.

The lab quizzes are to be completed individually, but afterward, students work in groups of 2, and you may choose your own partner. Students will be assigned a mark based on their performance on the conceptual quiz (individual) and the completion of a worksheet (done with a partner).

**Labs start the week of 18 January 2021.**

## TUTORIALS

There are no tutorials in ECE221. Instead, tutorial teaching assistants will hold one-on-one private sessions with students to assist them with course material, which can be booked on the course website.

## TERM WORK PETITIONS

If you are unavoidably absent and miss term work (e.g. test, quiz, assignment, lab), discuss the matter with your instructor immediately. If necessary, submit a term work petition.

All term work petitions must be submitted through the online petition system, which is accessible through the Engineering Portal: <https://portal.engineering.utoronto.ca>

**Term work petitions must be submitted within seven days of the term work in question and include valid documentation.**

For further information about petitions, see: <http://uoft.me/petitions>

## ACADEMIC OFFENCES

Students should familiarize themselves with the University of Toronto Code of Behaviour on Academic Matters, a link to which can be found on the course website. The Code establishes a responsibility between the University and its members to ensure that a climate which might encourage, or conditions which might enable, cheating, misrepresentation or unfairness not be tolerated. To this end, all must acknowledge that seeking credit or other advantages by fraud or misrepresentation, or seeking to disadvantage others by disruptive behaviour is unacceptable, as is any dishonesty or unfairness in dealing with the work or record of a student.

In completing the assessments in this course, the following is relevant. It shall be an offence for a student knowingly:

1. to forge or in any other way alter or falsify any document or evidence required by the University, or to utter, circulate or make use of any such forged, altered or falsified document, whether the record be in print or electronic form;
2. to use or possess an unauthorized aid or aids or obtain unauthorized assistance in any academic examination or term test or in connection with any other form of academic work;
3. to personate another person, or to have another person personate, at any academic examination or term test or in connection with any other form of academic work;
4. to represent as one's own any idea or expression of an idea or work of another in any academic examination or term test or in connection with any other form of academic work, i.e. to commit plagiarism;
5. to submit, without the knowledge and approval of the instructor to whom it is submitted, any academic work for which credit has previously been obtained or is being sought in another course or program of study in the University or elsewhere;
6. to submit any academic work containing a purported statement of fact or reference to a source which has been concocted.

Academic offences will be directly referred to and dealt with by the Dean's office.