

# Electromagnetic Fields (ECED 3300)

## Course Outline

**Instructor:** Dr. Sergey Ponomarenko (office: C313; phone: × 3270; email: serpo@dal.ca ).

**Course website:** [www.top.ece.dal.ca](http://www.top.ece.dal.ca).

**Office hours:** Monday 2:00 to 3:00 pm or by appointment.

### Objectives

- To learn fundamental laws governing behaviour of electric and magnetic fields.
- To learn to apply these laws to solve basic problems of electromagnetics.

### Syllabus

#### Part I. Vector Calculus: A Brief Review

- Gradient & Divergence
- Gauss's Theorem
- Curl & Laplacian
- Stokes's Theorem

#### Part II. Electrostatic Fields in Free Space

- Coulomb's Law
- Electric Field; Superposition Principle
- Gauss's Law
- Electrostatic Potential
- Electrostatic Energy

#### Part III. Electrostatic Fields in Materials

- Conductors & Dielectrics
- Polarization
- Boundary Conditions in Dielectrics

#### Part IV. Electrostatic Boundary-value Problems

- Laplace's & Poisson's Equations
- Method of Images
- Capacitors and Electrostatic Energy

#### Part V. Electric Currents

- Electric Charge Conservation & Continuity Equation
- Stationary Electric Currents

- Resistance

## **Part VI. Magnetostatic Fields in Free Space**

- Bio-Savart's Law
- Ampère's Law
- Magnetic Flux and Absence of Magnetic Charges
- Magnetic Scalar & Vector Potentials

## **Part VII. Magnetic Fields & Forces in Materials**

- Magnetization in Materials
- Magnetic Forces & Torques
- Magnetic Boundary Conditions

## **Part VIII. Electromagnetic Induction**

- Inductance & Inductors
- Electromagnetic Induction
- Displacement Currents
- Maxwell's Equations

## **Textbooks**

- Lecture Notes available at <http://www.top.ece.dal.ca>.
- "Elements of Electromagnetics" by Matthew N. O. Sadiku, 6th Ed., Oxford U. Press, 2010.

## **Format**

- Lectures (3 hours/week) + Tutorials/Laboratories (2 hours/week) + six homework assignments.

## **Examinations**

- **Midterm Exam (October 27, Sexton Gym, 2:35 to 4:35 pm)** and **Final Exam (TBD, 3 hours)**: closed-book, written exams with formula sheets provided and no calculators allowed.

## **Grading**

1. Homework 20%
2. Midterm 33%
3. Final 47%

## **Notes**

- Two grades will be calculated: one including the midterm and the other without it, and the **higher** will determine the final grade, i.e.,

$$\text{Final Grade} = \text{Max}(20\%H + 33\%M + 47\%F; 20\%H + 80\%F).$$

- Should you miss the midterm for a legitimate reason, its final grade weight will be shifted to the final exam.
- There will be no supplementary examination to this course.
- Tutorial Schedule is enclosed below.
- **Writing expectations at university are higher than you will have experienced at high school (or if you are entering a master's or PhD program, the expectations are higher than at lower levels). The Writing Centre is a Student Service academic unit that supports your writing development. Make an appointment to discuss your writing. Learning more about the writing process and discipline-specific practices and conventions will allow you to adapt more easily to your field of study.**

**Dalhousie Writing Centre Main Location (Learning Commons, Main Floor)**

Monday & Tuesday 10-7

Wednesday & Thursday 10-9

Friday 10-4 Sunday 12-5

**At Sexton (Room A108)**

Wednesday 6-9 pm

Friday 9 am - 12 pm

- **Accommodation Policy for Students**

**Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic under the Nova Scotia Human Rights Act. Students who require academic accommodation for either classroom participation or the writing of tests, quizzes and exams should make their request to the Office of Student Accessibility & Accommodation (OSAA) prior to or at the outset of each academic term (with the exception of X/Y courses). Please see [www.studentaccessibility.dal.ca](http://www.studentaccessibility.dal.ca) for more information and to obtain Form A - Request for Accommodation. A note taker may be required to assist a classmate. There is an honourarium of \$75/course/term. If you are interested, please contact OSAA at 494-2836 for more information. Please note that your classroom may contain specialized accessible furniture and equipment. It is important that these items remain in the classroom so that students who require their usage will be able to participate in the class.**

**Tutorial & Exam Schedule**

1. Tutorial 1 (Vector Calculus)–September 19;
2. Tutorial 2 (Gauss's Law)–September 26;
3. Tutorial 3 (Electrostatic Potential and Dielectrics)–October 17;
4. Tutorial 4 (Images & Capacitors)–October 24;
5. **Midterm**–October 27, Sexton Gym, 2:35 to 4:35 pm
6. **Midterm Review**–November 14
7. Tutorial 5 (Magnetostatics)–November 21;
8. Tutorial 6 (Electromagnetic Induction)–November 28.