PHYC 3100 Electrodynamics

Department of Physics and Atmospheric Science

Fall 2023

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Lecturer

Prof. Ted Monchesky, e-mail: Theodore.Monchesky@Dal.Ca, office: Dunn Rm 239

TA

Brett MacNeil, e-mail: brett.macneil@dal.ca

Lectures

Tuesday and Thursday, LSC 206, 11:35 am – 12:55 pm

Tutorials

Wednesday, Dunn 302, 4:05 pm – 5:25 pm

Course Delivery

In-person

Course Description

This course presents the fundamental theory of time dependent electromagnetic phenomena with a focus on electromagnetic waves in vacuum. Topics include Maxwell's equations, conservation laws for electromagnetic fields, electromagnetic waves and radiation, guided waves and relativistic electrodynamics.

Course Prerequisites

PHYC 2510.03 Electricity and Magnetism or equivalent

Learning Objectives

- Understand classical electrodynamical phenomena in terms of Maxwell's equations
- Solve problems involving the generation of electromagnetic waves and the motion of charged particles
- Identify the symmetry of a problem and choose appropriate techniques to take advantage it
- Justify an approach to problem solving and articulate it both orally and in written form.
- Check the reasonableness of a solution through a variety of techniques, such as taking limiting cases, application of dimensional analysis, use of dimensional analysis and analysis of the symmetry of a solution.

Course Materials

Required textbook:

- *Introduction to Electrodynamics*, 4th Ed., D. J. Griffiths, (Pearson, 2013). This is one of my favourite undergraduate textbooks and is widely adopted for undergraduate electricity and magnetism and electrodynamics courses.

Recommended reference textbooks:

- *Electromagnetism,* G. Pollack and D. Stump, (Addison-Wesley, 2001)
- *Lectures on Physics, Vol II*, R. P. Feynman, R. B. Leighton and M. Sands, (Addison-Wesley, 1965).
  It is worth having a look at Feynman's unique insights into electrodynamics.
- *Classical Electrodynamics*, 3rd, J. D. Jackson (John Wiley & Sons, 1999)
  This is a classical textbook used universally in graduate level courses and is considered the bible of electrodynamics. The problems are notoriously difficult. The 3rd Edition in is SI units.

- *Modern Electrodynamcs,* A. Zangwill (Cambridge University Press, 2012)
  This an excellent graduate level textbook with a more modern treatment of Jackson's classical graduate textbook.

Course website:
Brightspace

Announcements
Announcements pertaining to lectures and laboratory will be made via e-mail.

Course Assessment

	Method 1	Method 2
1st Midterm	17%	best of two quizzes 22%
2nd Midterm	17%	
Tutorials	2%	2%
Assignments	30%	30%
Exam	33%	45%
	100%	100%

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale, shown below.

A+ (90-100)	**B+** (77-79)	**C+** (65-69)	**D** (50-54)
A (85-89)	**B** (73-76)	**C** (60-64)	**F** (<50)
A- (80-84)	**B-** (70-72)	**C-** (55-59)	

Course Policies on Missed or Late Academic Requirements
Midterm: There is no make-up test for a missed midterm: method 2 will automatically be applied in this case to calculate your final grade.
Exam: If a student misses the final exam for good reason, they should contact the Lecturer as soon as possible and sub and submit a
Problem Sets: Late assignment will have 10% deducted per day after the due date, and no credit will be given for assignments handed in after the solutions have been provided. If you are unable to submit an assignment for good reason, you need to contact the Lecturer as soon as possible and submit a "Student Declaration of Absence form" upon return to class. For a valid excuse, an extension will be provided when possible; otherwise the assignment mark will be dropped.

Course Policies related to Academic Integrity
You are encouraged to work on problem sets together, but the assignment that you hand in **must** be in your own words, and the calculations **must** be your own. When you complete your assignments, make sure that you explain your thought process. Putting your thoughts into words is a very useful way of learning the material more deeply.

The problem sets will be approximately every week and will be due on Thursday at the start of the tutorial.

Midterms
1st Midterm: evening of Monday Oct. 16
2nd Midterm: evening of Monday Nov. 13

Lectures and Reading Assignments

The following is a rough outline for the lectures, subject to change depending of the needs of the class. You are expected to read the relevant chapters in the textbook before coming to class. Lecture notes will be posted on Brightspace.

Date	Unit		Lecture	Chapter
05-Sep	1. Magnetostatics	**1**	Review of electricity and magnetism	2, 5.1 - 5.2
07-Sep		**2**	Ampere's Law	5.3
12-Sep		**3**	Vector Potential	5.4
14-Sep	2. Electrodynamics	**4**	Electromotive force	7.1
19-Sep		**5**	Faraday's Law	7.2
21-Sep		**6**	Energy in magnetic fields	7.2
26-Sep		**7**	Maxwell's Equations	7.3
28-Sep	3. Conservation Laws	**8**	Conservation of charge and energy	8.1
03-Oct		**9**	Conservation of momentum	8.2
05-Oct		**10**	Work and magnetic forces	8.3
10-Oct	4. Waves	**11**	Waves in one dimension	9.1
12-Oct		**12**	Electromagnetic waves in vacuum	9.2
17-Oct		**13**	Electromagnetic waves in matter	9.3
19-Oct		**14**	Absorption and dispersion	9.4
24-Oct		**15**	Absorption and dispersion in insulators	9.5
26-Oct	5. Potentials	**16**	The potential formulation	10.1
31-Oct		**17**	Continuous distributions	10.2
02-Nov		**18**	Points charges	10.3
07-Nov			**Reading week**	
09-Nov				
14-Nov	6. Radiation	**19**	Dipole radiation	11.1
16-Nov		**20**	Point charges	11.2
21-Nov	7. Relativity	**21**	Special relativity	12.1
23-Nov		**22**	Relativistic mechanics	12.2
28-Nov		**23**	Relativistic electrodynamics	12.3.1 - 12.3.2
30-Nov		**24**	The field tensor	12.3.3

University Policies and Statements

Recognition of Mi'kmaq Territory
Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization
At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: https://www.dal.ca/about-dal/internationalization.html

Academic Integrity
At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility
The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html)

Conduct in the Classroom – Culture of Respect
Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect
Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: http://www.dal.ca/cultureofrespect.html

Student Code of Conduct
Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy
The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software
The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html

Student Use of Course Materials
Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

Student Resources and Support

University Policies and Programs
Important Dates in the Academic Year (including add/drop dates): http://www.dal.ca/academics/important_dates.html
Classroom Recording Protocol: https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html
Dalhousie Grading Practices Policies: https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html
Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html
Sexualized Violence Policy: https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html
Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

Learning and Support Resources
General Academic Support – Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html
General Academic Support – Advising (Truro): https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html
Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html
On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html
Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html
Indigenous Connection: https://www.dal.ca/about-dal/indigenous-connection.html
Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803: https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf
Black Student Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html
International Centre: https://www.dal.ca/campus_life/international-centre.html
South House Sexual and Gender Resource Centre: https://southhousehalifax.ca/about/
LGBTQ2SIA+ Collaborative: https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html
Dalhousie Libraries: http://libraries.dal.ca/
Copyright Office: https://libraries.dal.ca/services/copyright-office.html
Dalhousie Student Advocacy Services: https://www.dsu.ca/dsas?rq=student%20advocacy
Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html
Human Rights and Equity Services: https://www.dal.ca/dept/hres.html
Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html
Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html
Faculty of Science Advising Support: https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html