

PHYC 3100 Electrodynamics

Department of Physics and Atmospheric Science

Fall 2022

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

We acknowledge the histories, contributions, and legacies of the African Nova Scotian people and communities who have been here for over 400 years.

Instructor

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TA

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Lectures

Tuesday and Thursday, McCain 1102, 10:05 to 11:25

Tutorials

TBD

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 of 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 is in SI units.

- *Modern Electrodynamics*, 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

Late assignments 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. For a justified missed midterm tests or exam a “Student Declaration of Absence form” must be submitted. There is no make-up test for a missed midterm: method 2 will automatically be applied in this case to calculate your final grade. If the final exam is missed for good reason, a make-up exam will be given.

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. 17
2nd Midterm: evening of Monday Nov. 14

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
Sep 6	1. Magnetostatics	1 Review of electricity and magnetism	2, 5.1 - 5.2
Sep 8		2 Ampere's Law	5.3
Sep 13		3 Vector Potential	5.4
Sep 15	2. Electrodynamics	4 Electromotive force	7.1
Sep 20		5 Faraday's Law	7.2
Sep 22		6 Energy in magnetic fields	7.2
Sep 27		7 Maxwell's Equations	7.3

Sep 29	3. Conservation Laws	8	Conservation of charge and energy	8.1
Oct 4		9	Conservation of momentum	8.2
Oct 6		10	Work and magnetic forces	8.3
Oct 11	4. Waves	11	Waves in one dimension	9.1
Oct 13		12	Electromagnetic waves in vacuum	9.2
Oct 18		13	Electromagnetic waves in matter	9.3
Oct 20		14	Absorption and dispersion	9.4
Oct 25		15	Guided waves	9.5
Oct 27	5. Potentials	16	The potential formulation	10.1
Nov 1		17	Continuous distributions	10.2
Nov 3		18	Points charges	10.3
Nov 8		Reading week		
Nov 10				
Nov 15	6. Radiation	19	Dipole radiation	11.1
Nov 17		20	Point charges	11.2
Nov 22	7. Relativity	21	Special relativity	12.1
Nov 24		22	Relativistic mechanics	12.2
Nov 29		23	Relativistic electrodynamics	12.3.1 - 12.3.2
Dec 1		24	The field tensor	12.3.3
Dec 6		25	Review	

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of 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.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.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.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

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

Statement: <http://www.dal.ca/cultureofrespect.html>

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 (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

<https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&chapterid=-1&topicgroupid=31821&loadusercredits=False>

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

Dalhousie COVID-19 information and updates: <https://www.dal.ca/covid-19-information-and-updates.html>