

# PHYC 3100 Electrodynamics – Provisional Syllabus

Department of Physics and Atmospheric Science

September 18<sup>th</sup> 2025

*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](mailto:Theodore.Monchesky@Dal.ca), office: Dunn Rm 239

Because this is a small class, I don't have set office hours. You are welcome to drop-by or set an appointment if you prefer.

## TA

Xander Marshal, e-mail : [Xander.Marshall@Dal.ca](mailto:Xander.Marshall@Dal.ca), office : Dunn Rm 243

## Lectures

Dunn 221C (to be confirmed), MWF 4:35 am – 5:25 am

## Tutorials

Dunn 221C, Friday 1:05 pm – 2:25 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, and relativistic electrodynamics.

## Course Prerequisites

PHYC 2510.03 Electricity and Magnetism or equivalent

## Learning Objectives

- Explain classical electrodynamical phenomena using Maxwell's equations.
- Analyze the symmetry of a problem and select mathematical techniques that exploit it.
- Solve quantitative problems involving the generation and propagation of electromagnetic waves.
- Justify and communicate chosen problem-solving approaches clearly.
- Evaluate the validity of solutions using techniques such as limiting cases, dimensional analysis, and symmetry arguments.

## Course Materials

### Required textbook:

- *Introduction to Electrodynamics*, 4th Ed., D. J. Griffiths, (Pearson, 2013). Although this is one of my favourite undergraduate textbooks and is widely adopted for undergraduate electricity and magnetism and electrodynamics courses, I find parts of the second half of the book lacking. You may want to consult other references to supplement your reading.

### Recommended reference textbooks:

- G. Pollack and D. Stump, *Electromagnetism*, (Addison-Wesley, 2001)
- M. A. Heald and J. B. Marion *Classical Electromagnetic Radiation* 3<sup>rd</sup> Ed., (Saunders College Publishing, Fort Worth, 1995). This a good undergraduate level text that focuses on radiation and waves. Note that the book uses CGS units (See Griffiths Appendix C for a discussion about converting between SI and CGS).
- R. P. Feynman, R. B. Leighton and M. Sands *Lectures on Physics, Vol II*, (Addison-Wesley, 1965). It is worth having a look at Feynman's unique insights into electrodynamics.

- J. D. Jackson *Classical Electrodynamics*, 3<sup>rd</sup>, (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 3<sup>rd</sup> Edition is in SI units (mostly!).
- A. Zangwill *Modern Electrodynamics*, (Cambridge University Press, 2012)  
This is an excellent graduate level textbook with a more modern treatment of Jackson's classical graduate textbook. I use this in my graduate electrodynamics course.

**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	34%	46%
	100%	100%

Conversion of numerical grades to Final Letter Grades follows the [Dalhousie Common Grade Scale](#), shown below.

<b>A+</b> (90-100)	<b>B+</b> (77-79)	<b>C+</b> (65-69)	<b>D</b> (50-54)
<b>A</b> (85-89)	<b>B</b> (73-76)	<b>C</b> (60-64)	<b>F</b> (<50)
<b>A-</b> (80-84)	<b>B-</b> (70-72)	<b>C-</b> (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 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 except for the weeks with midterms.

**Midterms**

Tentative dates:

1st Midterm: Tuesday Oct. 14, 6:00 – 7:30 PM

2nd Midterm: Tuesday Nov. 18, 6:00 – 7:30 PM

**Tutorials**

The tutorials involve problems that you work on in small groups. Your participation and effort during the tutorials will be graded on a scale from 0 to 2. You will be permitted to miss one week of tutorial without question. Any absence beyond this will require a "Student Declaration of Absence form".

## 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	#	Lecture topic	Reading Assignment
Sep 24	1	Electrostatics	2.1 -- 2.5
Sep 26	2	Biot-Savart Law	5.1 -- 5.4
Sep 29	3	Ampere's Law	
Oct 01	4	Vector Potential	
Oct 03	5	Currents	7 -- 7.3
Oct 06	6	EMF	
Oct 08	7	Faraday's Law	
Oct 10	8	Inductance	
Oct 13		<i>Thanksgiving</i>	
Oct 15	9	Energy in magnetic fields	
Oct 17	10	Ampere's Law revisited	
Oct 20	11	Maxwell's equations	
Oct 22	12	Conservation of energy	
Oct 24	13	Conservation of momentum	8.1 -- 8.2
Oct 27	14	Maxwell stress tensor	
Oct 29	15	stress tensor (con't)	
Oct 31	16	Plane waves	9.1 -- 9.2
Nov 03	17	Energy in plane waves	
Nov 05	18	Reflection and transmission in insulators	9.3 -- 9.4
Nov 07	19	Brewster's angle	
Nov 10 - Nov 14		<i>Study Break</i>	
Nov 17	20	Reflection and transmission in metals	
Nov 19	21	Absorption and dispersion	
Nov 21	22	Absorption and dispersion (con't)	
Nov 24	23	Lorentz gauge	10.1 -- 10.3
Nov 26	24	Retarded potentials	
Nov 28	25	Potentials from moving point charge	
Dec 01	26	Charge moving at constant $v$	
Dec 03	27	Fields from moving point charge	11.1 -- 11.3
Dec 05	28	Radiation	
Dec 08	29	Radiation in the far field	
Dec 10	30	(con't)	

## 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](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at: [https://www.dal.ca/campus\\_life/communities/indigenous.html](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](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](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](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](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](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](http://www.dal.ca/academics/important_dates.html)

Classroom Recording Protocol: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/classroom-recording-protocol.html](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](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](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](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](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](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](https://www.dal.ca/campus_life/academic-support/On-track.html)

Indigenous Student Centre: [https://www.dal.ca/campus\\_life/communities/indigenous.html](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](mailto: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](https://www.dal.ca/campus_life/communities/black-student-advising.html)

International Centre: [https://www.dal.ca/campus\\_life/international-centre.html](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](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](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](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>