



### COURSE OUTLINE

1. **Course:** PHYS 457, Electromagnetic Theory III - Winter 2020

Lecture 01: MWF 13:00 - 13:50 in ST 128

Instructor	Email	Phone	Office	Hours
Dr Eric Donovan	edonovan@ucalgary.ca	403 220-6337	SB 638	Thursdays 10:00-11:30 AM

**Course Site:**

D2L: PHYS 457 L01-(Winter 2020)-Electromagnetic Theory III

**Note:** Students must use their U of C account for all course correspondence.

2. **Requisites:**

See section [3.5.C](#) in the Faculty of Science section of the online Calendar.

**Prerequisite(s):**

Physics 455 and one of Physics 435 or Mathematics 433.

**Antirequisite(s):**

Credit for Physics 457 and Electrical Engineering 476 will not be allowed.

3. **Grading:**

The University policy on grading and related matters is described in [F.1](#) and [F.2](#) of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Component(s)	Weighting %	Date
Test 1	15	January 31st, 2020, in class
Test 2	15	February 28th, 2020, in class
Test 3	15	April 3rd, 2020, in class
Final Exam	30	TBD
Homework	20	Ongoing
In class	5	Ongoing

Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student's grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

The conversion between a percentage grade and letter grade is as follows.

	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
<b>Minimum % Required</b>	95 %	90 %	87 %	84%	81%	78 %	75 %	72%	69%	66 %	60 %

This course has a registrar scheduled final exam.

4. **Missed Components Of Term Work:**

In the event that a student misses the midterm or any course work due to illness, supporting documentation, such as a medical note or a statutory declaration will be required (see [Section M.1](#); for more information regarding the use of statutory declaration/medical notes, see [FAQ](#)). Absences must be reported within 48 hrs.

The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in [Section 3.6](#). It is the student's responsibility to familiarize themselves with these regulations. See also [Section E.3](#) of the University Calendar.

5. **Scheduled Out-of-Class Activities:**

There are no scheduled out of class activities for this course.

6. **Course Materials:**

Required Textbook(s):

David J. Griffiths, *Introduction to Electrodynamics*: Addison Wesley.

There will be videos reviewing math, doing examples and derivations posted for the students to learn from. Students are expected to watch these videos on their own time. This will be discussed in class.

7. **Examination Policy:**

Students will be provided a formula sheet for both the midterms and the final.

Students should also read the Calendar, [Section G](#), on Examinations.

8. **Approved Mandatory And Optional Course Supplemental Fees:**

There are no mandatory or optional course supplemental fees for this course.

9. **Writing Across The Curriculum Statement:**

For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also [Section E.2](#) of the University Calendar.

10. **Human Studies Statement:**

Students will not participate as subjects or researchers in human studies.

See also [Section E.5](#) of the University Calendar.

11. **Reappraisal Of Grades:**

A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See [Section I.3](#) of the University Calendar.

- a. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **ten business days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall submit the Reappraisal of Graded Term work form to the department in which the course is offered within 2 business days of receiving the decision from the instructor. The Department will arrange for a reappraisal of the work within the next ten business days. The reappraisal will only be considered if the student provides a detailed rationale that outlines where and for what reason an error is suspected. See sections [I.1](#) and [I.2](#) of the University Calendar
- b. **Final Exam:** The student shall submit the request to Enrolment Services. See [Section I.3](#) of the University Calendar.

12. **Other Important Information For Students:**

- a. **Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, [Mental Health Services Website](#)) and the Campus Mental Health Strategy website ([Mental Health](#)).
- b. **SU Wellness Center:** The Students Union Wellness Centre provides health and wellness support for students including information and counselling on physical health, mental health and nutrition. For more information, see [www.ucalgary.ca/wellnesscentre](http://www.ucalgary.ca/wellnesscentre) or call [403-210-9355](tel:403-210-9355).
- c. **Sexual Violence:** The University of Calgary is committed to fostering a safe, productive learning environment. The Sexual Violence Policy (<https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf>) is a fundamental element in creating and sustaining a safer campus environment for all

community members. We understand that sexual violence can undermine students' academic success and we encourage students who have experienced some form of sexual misconduct to talk to someone about their experience, so they can get the support they need. The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email ([svsa@ucalgary.ca](mailto:svsa@ucalgary.ca)) or phone at [403-220-2208](tel:403-220-2208).

- d. **Misconduct:** Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under [Section K](#). Student Misconduct to inform yourself of definitions, processes and penalties. Examples of academic misconduct may include: submitting or presenting work as if it were the student's own work when it is not; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; collaborating in whole or in part without prior agreement of the instructor; borrowing experimental values from others without the instructor's approval; falsification/ fabrication of experimental values in a report. **These are only examples.**
- e. **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).
- f. **Academic Accommodation Policy:** Students needing an accommodation because of a disability or medical condition should contact Student Accessibility Services in accordance with the procedure for accommodations for students with disabilities available at [procedure-for-accommodations-for-students-with-disabilities.pdf](#).  
  
Students needing an accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Associate Head of the Department of Physics & Astronomy, Dr. David Feder by email [phas.ahugrd@ucalgary.ca](mailto:phas.ahugrd@ucalgary.ca) or phone 403-220-8127. Religious accommodation requests relating to class, test or exam scheduling or absences must be submitted no later than **14 days** prior to the date in question. See [Section E.4](#) of the University Calendar.
- g. **Safewalk:** Campus Security will escort individuals day or night (See the [Campus Safewalk](#) website). Call [403-220-5333](tel:403-220-5333) for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- h. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see [Legal Services](#) website.
- i. **Student Union Information:** [VP Academic](#), Phone: [403-220-3911](tel:403-220-3911) Email: [suvpaca@ucalgary.ca](mailto:suvpaca@ucalgary.ca). SU Faculty Rep., Phone: [403-220-3913](tel:403-220-3913) Email: [sciencerep@su.ucalgary.ca](mailto:sciencerep@su.ucalgary.ca). [Student Ombudsman](#), Email: [ombuds@ucalgary.ca](mailto:ombuds@ucalgary.ca).
- j. **Internet and Electronic Device Information:** Unless instructed otherwise, cell phones should be turned off during class. All communication with other individuals via laptop, tablet, smart phone or other device is prohibited during class unless specifically permitted by the instructor. Students that violate this policy may be asked to leave the classroom. Repeated violations may result in a charge of misconduct.
- k. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction ([USRI](#)) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.
- l. **Copyright of Course Materials:** All course materials (including those posted on the course D2L site, a course website, or used in any teaching activity such as (but not limited to) examinations, quizzes, assignments, laboratory manuals, lecture slides or lecture materials and other course notes) are protected by law. These materials are for the sole use of students registered in this course and must not be redistributed. Sharing these materials with anyone else would be a breach of the terms and conditions governing student access to D2L, as well as a violation of the copyright in these materials, and may be pursued as a case of student academic or [non-academic misconduct](#), in addition to any other remedies available at law.

## Course Material (Syllabus)

### Review of Relevant Math Tools

Basic Tensors and Vector Calculus  
Gauss's Theorem, Stokes' Theorem

### Electrodynamics

Electromotive Force: Ohm's law, Joule heating, Motional EMF  
Electromagnetic Induction: Faraday's & Lenz's laws, Induced E-field, Inductance  
Electromagnetic Energy: Review of E-field Energy, Introduction to B-field Energy  
Maxwell's equations: displacement & polarization current, boundary conditions

### Conservation laws

Conservation Relations: Mathematic Form  
Conservation of Charge and Energy: Continuity Equation, Poynting Flux  
Momentum: Maxwell Stress Tensor, Momentum Flux Density, Angular Momentum

### Electromagnetic waves

Waves in 1D: Wave Equation, Sinusoids, Reflection & Transmission, Polarization  
Waves in Vacuum: EM Wave Equation, Monochromatic Plane Waves, Energy & Momentum  
Waves in Matter: Linear Media, Normal Incidence Reflection & Transmission, Oblique Incidence, Snell's Law, Fresnel Equations, Brewster's Angle  
Absorption and Dispersion: Waves in Conductors, Reflection at Conductors, Group Velocity, Phase Velocity, Dispersion  
Guided Waves: Wave Guides, TE/TM, Cutoff Frequency, Coaxial Transmission Lines  
Potential Formulation: Scalar and Vector potentials, Gauge Transformations, Coulomb Gauge, Lorentz Gauge  
Continuous Distributions: Retarded Potentials, Jefimenko's Equations  
Point Charges: Lienard-Weichert Potentials, Moving Point Charges

How we'll spend classroom time:

I believe in active learning and everyone participating in discussion; lectures will therefore follow the book closely and involve questions to keep students engaged.

Bring:

- Paper and pen/pencil and notebook to keep notes on the material
- Way of answering student response questions (clicker questions, like a cell phone, laptop or tablet)

If you fall behind or have trouble, please come to me and we can figure out what can be done about it. The earlier in the course you approach me the more help I can be.

**Homework** - Homework will be keeping up with the questions, largely from the book.

### **Assessments:**

1. Homework Questions Due: TBD Value: 20%

You will be assigned questions to do outside of class. Some of these questions will be written specifically for this class, and some will come from the textbook. You will write up these questions and turn them at the beginning of the class period. There will be six assignments.

Assessment Criteria: Turn them in, and then accuracy and clarity of work (if late they will be marked down 20%/day they are late unless discussed specifically with the instructor).

2. In-class activities Due: Most class periods Value: 5%

You will be doing work on various problems in class (worksheets, clicker questions etc.) which will be assessed in real time or turned in at the end of class.

Assessment Criteria: Completion.

3. In-Class Tests      Date: three in term, during class      Value: 45%

Tests will cover material from the assignments and the book.

Assessment Criteria: Clear demonstration of work done, neatness and readability, and the correct answer. A correct answer with no work, or indecipherable work will not receive full credit. If you have special requirements for exams, please let me know as soon as possible.

4. Final Exam      Date: TBD by registrar      Value: 30%

The final exam will cover Chapters 7 through the beginning of Chapter 11.

Assessment Criteria: This exam will cover material from lecture, the assignments and the book. You'll be marked on material comprehension and how well you can communicate the material on the exams.

**Course Learning Incomes:**

Students taking PHYS 457 are expected to have prior knowledge in vector calculus, differential equations and the one-dimensional wave equation and complex numbers. Students are expected to have some familiarity with electromagnetism, specifically, students are expected to have a thorough working knowledge of electrostatics and magnetostatics. Additionally, there is an expectation that students will be able to analyze basic circuit elements (resistor, capacitor, inductor), LRC circuits, and damped driven harmonic oscillators.

**Course Outcomes:**

- Recognize that electricity, magnetism, and optics can be described and explained with a unified set of concepts
- Utilize mathematical properties of vectors, differential, and integral calculus in curvilinear coordinate systems
- Express the relationships between electric charges, electric currents, electric fields, and magnetic fields in terms of Maxwell's equations with integral and differential forms
- Understand that fields, like particles, can have properties such as energy and momentum. Represent electric and magnetic fields using scalar and vector potentials. Explain conservation and continuity properties in terms of the Poynting vector and Maxwell stress tensor
- Be able to derive the wave equation for electrodynamics and understand the interaction between time-changing fields and potentials. Apply this formalism to show how electromagnetic waves propagate in vacuum, matter, waveguides, and across interfaces. Discover Snell's law, polarization at grazing incidence, and why the sky is blue
- Apply multipole expansions to calculate physical phenomena involving electromagnetic radiation and understand validity of near-field and far-field approximations
- Extend electromagnetism to include relativistic effects

Electronically Approved - Jan 10 2020 11:28

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**Department Approval**