



UNIVERSITY OF CALGARY  
FACULTY OF SCIENCE  
DEPARTMENT OF PHYSICS & ASTRONOMY  
COURSE OUTLINE

1. **Course:** PHYS 455, Electromagnetic Theory II -- Fall 2018

Instructor Name	Email	Phone	Office	Hours
<i>L01:</i> ( MWF 13:00 - 13:50 in SB 105)				
Jason Donev	jmdonev@ucalgary.ca	403-210-6343	SA 101A	Monday 10-11:30, Tuesday 13:00-14:30, Friday 14:00-15:30

**Course Site:**

D2L: PHYS 455 L01-(Fall 2018)-Electromagnetic Theory II

**Department of Physics & Astronomy:**

Office: Science B 605  
Phone: 403 220-5385  
Email: phasoffice@ucalgary.ca

**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 255 or 323; and Applied Mathematics 309 or Mathematics 353 or 377.

**Antirequisite(s):** Credit for both Physics 455 and Electrical Engineering 475 will not be allowed.

**Notes:** Prior completion of or concurrent registration in Applied Mathematics 433 is highly recommended.

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
Midterm 1	20	Oct 10th
Midterm 2	20	Nov 9th
Final Exam	30	TBD
Homework	25	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 %	85 %	80%	75%	70 %	65 %	60%	55%	50 %	45 %

This course has a registrar scheduled final exam.

#### 4. Missed Components of Term Work:

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 himself/herself/themself 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 .

Recommended Textbook(s):

Schey, *DIV, Grad, Curl, and All That: An Informal Text on Vector Calculus*: Norton .  
Fleisch, *A Student's Guide to Maxwell's Equations*: Cambridge .

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:

Non-programmable calculators will be allowed on all exams. 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.

1. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **15 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 immediately submit the Reappraisal of Graded Term work form to the department in which the course is offered. The department will arrange for a re-assessment of the work if, and only if, the student has sufficient academic grounds. See sections [I.1](#) and [I.2](#) of the University Calendar
2. **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: [suvpaca@ucalgary.ca](mailto:suvpaca@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.

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. Education research-based questions will be asked in class during the lectures to help students understand the material better.

Bring:

- A calculator
- 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 & Projects** - Homework will be keeping up with the questions, largely from the book.

### **Assessments:**

1. Homework Questions    Due: Once a week, most weeks    Value: 25%

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.

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. Midterm Exams    Date: twice in term    Value: 40%

Exams will cover material from the assignments and the book. The first exam will cover Chapters 1&2. The second exam will cover Chapters 3&4.

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 1-6 with a focus on 5&6.

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.

### **Topics that will be covered in class:**

#### **Vector Analysis**

Vector Algebra: operations, component form, triple products

Differential Calculus: "del" operator, gradient, divergence, curl

Integral Calculus: line, surface, volume integrals

Curvilinear coordinates: spherical, cylindrical

Dirac delta function, vector fields

## **Electrostatics**

Electric field, Coulomb's law, field lines, flux

Gauss's law, divergence, curl

Electric Potential, Poisson's equation, Laplace's equation

Work and energy: single charge, point charges, continuous distribution

Conductors: properties, induced charges, surface charge, capacitors

## **Special techniques**

Laplace's equation: 1D, 2D, 3D, boundary conditions, uniqueness theorem

Method of images: classic, induced surface charge, force and energy

Separation of variables: Cartesian, spherical

Multipole expansion: monopole, dipole, potentials at large distances

## **Electric fields in matter**

Polarization: dielectrics, induced dipoles, polar molecules

Polarized objects: bound charges, fields in dielectrics

Electric displacement  $D$ , Gauss's law, boundary conditions

## **Magnetostatics**

Lorentz force law: magnetic fields, forces, currents

Biot-Savart law: steady currents, magnetic fields

Divergence and curl: currents, Ampere's law

Magnetic vector potential: boundary conditions, multipole expansion

Magnetic fields in matter

Magnetization: diamagnets, paramagnets, ferromagnets, magnetic dipoles

Magnetized objects: bound currents, fields inside matter

$H$  field, Ampere's law in magnetized materials

Linear and nonlinear media, susceptibility and permeability

## **Course Learning Incomes**

Students taking PHYS 455 are expected to have an effective working knowledge of vector calculus, differential equations and first year electromagnetism.

**Department Approval:**

Electronically Approved

**Date:** 2018-08-27 20:05

## **Course Outcomes**

- Use Maxwell's equations for both electrostatics and magnetostatics
- Exploit the interrelationship between the electric and magnetic potentials and fields
- Articulate and employ the uniqueness theorems as they pertain to electrostatics
- Compare and contrast the behavior of electric and magnetic fields in matter and these fields in a vacuum
- Employ vector analysis to show how electric and magnetic fields are vector fields
- Model and analyze electrostatic and magnetostatic configurations using Cartesian, spherical and cylindrical coordinate systems
- Solve partial differential equations with the standard techniques for physics
- Express the boundary conditions relevant for electric and magnetic fields