UNIVERSITY OF CALGARY
FACULTY OF SCIENCE

Department of Physics & Astronomy
Science B 605
403 220-5385
phasoffice@ucalgary.ca

COURSE OUTLINE

1. **Course:** PHYS 255, Electromagnetic Theory I - Winter 2019

   Lecture 01: TR 11:00 - 12:15 in SA 106

Instructor	Email	Phone	Office	Hours
Nasser Moazzen-Ahmadi	nmoazzen@ucalgary.ca	403 830-4053	SB 525	M 10:00-11:00 A.M.

   Course description:

   This is the second course in physics for astrophysics and physics majors. We will discuss fundamental aspects of electromagnetic force, one of the four fundamental forces.

   Course Site:

   D2L: PHYS 255 L01-(Winter 2019)-Electromagnetic Theory I

   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 211 or 221 or 227; Applied Mathematics 217 or Mathematics 249 or 251 or 265 or 275 and admission to Physics, Astrophysics, Chemical Physics, Chemistry, Natural Science (Physics Concentration), or Environmental Science (Physics Concentration).

   Antirequisite(s):
   Credit for any of Physics 255 and 259 or 323 or 355 will not be allowed.

   Note(s):
   a. Prior completion of or concurrent registration in Mathematics 277 is highly recommended. Natural Sciences students without approved concentrations who are interested in concentrating in Physics should contact the Department for approval.

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
Assignments (Wiley Plus)	10%	
Laboratory experiments	20%	
In class quizzes	10%	
Midterm test (2)	30%	1st midterm : in class, Feb 14, 2019 2nd midterm: in class, March 21, 2019
Final Examination	30%	To be scheduled by the Registrar

   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
Minimum % Required	95 %	90 %	85 %	80%	75%	70 %	65 %	60%	55%	50 %	45 %

This course has a registrar scheduled final exam.

If the student obtains less than 50% on the combined mid-term and final exams, then the final grade will at most be a D+.

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 N.1; for more information regarding the use of statuary 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.

Missed Labs:

If you know ahead of time that you will miss a lab session due to a conflict, contact the course instructor as soon as possible to arrange for an accommodation. Please note that out-of-class midterms from other courses will not be considered as valid conflicts (see section on Out of Class Activities), but sports games, tournaments, etc. may be. It is up to the instructor to decide whether an accommodation will be granted.

Missed assignments:

Please contact the course instructor if you have a legitimate reason for missing a deadline for an assignment. Sleeping in, forgetting about the deadline etc. is not considered a legitimate reason.

Missed midterm:

If a student misses a make-up exam due to sickness or another documented reason, then the weight of the midterm will be added to the weight of the final exam. In cases where there is no approved justification for the absence, the student will receive a grade of zero on the exam.

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

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

REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME ACTIVITY .

If you have a conflict with any regularly scheduled component of this course (lecture, lab, or tutorial), you must seek accommodation from the course causing the conflict.

6. **Course Materials:**

Required Textbook(s):

Chabay and Sherwood, *Matter & Interactions, Fourth Edition*: Wiley.

Topics Covered:

Electric field, electric fields and matter, electric field of distributed charges, electric potential, magnetic field, electric field and circuits, magnetic force, patterns of field in space, Faraday's law, and electromagnetic radiation.

WileyPLUS Online Assignments:
Your text, Matter & Interactions by Chabay and Sherwood is available in the bookstore bundled with a WileyPLUS

code. A new text comes bundled with a code, which will give you access to the eText, assignments, read-study practice materials, and the assignment gradebook.

There are a few options available to you when it comes to the textbook and WileyPLUS access:

1. Buy the textbook bundle with the WileyPLUS code. Keep this code, as it will be used to access the online homework system.

2. Purchase just WileyPLUS access by itself. You will not have a physical copy of the textbook but you will get access to the eText. You can purchase this at the bookstore or directly from www.wileyplus.com.

3. If you are unable to purchase a new book or the WileyPLUS standalone, you will still be able to access the homework, but you must do so from the computers in the Taylor Family Digital Library. If you choose this option you will not have access to any of the other WileyPLUS materials (eText and read-study-practice materials), but you can upgrade to a full account at any time by purchasing the standalone. You will need to register as described below and choose the free option.

To register, please go to www.wileyplus.com, click the "Login" button on the top right hand corner, select "Log In to WileyPLUS", then enter your U of C email address as your username and your 8 digit student ID as your password.
Once you log in, you will be able to change your password. If you took the course last year and changed your password to something different than your student ID, the change will remain intact. For any technical support issues, go to www.wileyplus.com/support and choose the live chat option.

Assignment Schedule:

Assignment Name	**Dates of the Material Covered**	**Date Available to Students**	**Date Assignment is Due**
Assignment 0	Intro to WileyPLUS	January 10, 2019	January 17, 2019
Assignment 1	January 10-15	January 15, 2019	January 22, 2019
Assignment 2	January 17-22	January 22, 2019	January 29, 2019
Assignment 3	January 24-29	January 29, 2019	February 5, 2019
MT1 Practice	January 10-February 5	February 5, 2019	**N/A**
Assignment 4	February 7-12	February 12, 2019	February 26, 2019
Assignment 5	February 26-28	February 28, 2019	March 7, 2019
Assignment 6	March 5-7	March 7, 2019	March 14, 2019
MT2 Practice	February 7-March 12	March 12, 2019	**N/A**
Assignment 7	March 14-19	March 19, 2019	March 26, 2019
Assignment 7	March 26-28	March 28, 2019	April 4, 2019
Assignment 7	April 2-4	April 4, 2019	April 11, 2019
Final Practice	January 10-April 11	April 11, 2019	**N/A**

Laboratories:

You are not required to purchase any additional materials to complete the laboratory component in this course. The lab documents will be posted on D2L. They can then be accessed and printed off. Some of the labs require use of the programming language VPython, which you used in Phys 227. This is available for free and details on how to access and use VPython will be provided in the labs.

Labs will begin on January 14. The lab period will be a place to practice what is being learned in class in small groups.

These lab sections are 3 hours and except for labs on Biot Savart law and Charge to Mass Ratio should be finished entirely within the allotted time. Each lab that you complete will explain what it is you will have to submit, which will then be graded by the TA of your lab section.

For Biot Savart law and Charge to Mass Ratio laboratory reports are required. Further information on how to prepare a laboratory report will be provided by the laboratory instructor.

Date	Lab
January 14	VP01 Introduction to VPython

January 21	VPEM01+02+03
January 28	Electric Charges and Forces
February 04	VPEM04+VPEM05
February 11	Electric Potential Mapping
February 18	Reading break
February 25	VPEM06+VPEM07
March 04	Magnetic Fields and Forces
March 11	Biot Savart Law
March 18	Gauss's Law
March 25	Charge to Mass ratio
April 1	Faraday's law
April 9	Review for final exam

VP01 introduction to VPython	None, Sec. 1.4 (3D vectors) is useful.	Use VIDLE, the interactive editor for VPython Write a simple VPython program
VPEM01 Electric Field of Point Charge	Sec. 13.9 and VP01	Write a VPython program to calculate the electric field of a point charge at a particular observation location Create and scale an arrow to represent the net electric field at a particular observation location
VPEM02 Electric Field of a Dipole	Sec. 13.9 and VPEM01	Calculate and display the net electric field of several source charges, at many observation locations
VPEM03 Motion in a Dipole Field	Sec. 13.9 and VPEM02	Animate the motion of one or more charges under the influence of an electric field due to several source charges Monitor the sum of kinetic and potential energy for the system to check the accuracy of model predictions
VPEM04 Electric Field of a Uniformly Charged Rod	Sec. 15.9 and VPEM02	Create and use lists of many source charges and many observation locations in VPython Calculate and display the net electric field of a macroscopic uniformly charged object Discuss the effect of varying the number of point charges used to model a charged rod
VPEM05 Electric Field of a Uniformly Charged Ring	Sec. 15.9 and VPEM04	Create and use lists of many source charges and many observation locations in VPython Calculate and display the net electric field of a macroscopic uniformly charged object Discuss the effect of varying the number of point charges used to model a charged ring Compute the motion of a charged particle near a macroscopic uniformly charged object
VPEM06 Magnetic Field of a Moving Charged Particle	Sec. 17.9 and VPEM04	Calculate and display in VPython the magnetic field of a moving charge, at multiple observation locations
VPEM07 Moving Charged Particle in		Calculate and display in VPython the

Magnetic Field	Sec. 20.1 and VPEM06	motion of a charged particle moving in a uniform magnetic field

7. **Examination Policy:**

   Both scientific and graphing calculators are allowed during exams, but no network-enabled devices will be permitted.

   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 **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

    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 or call 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) or phone at 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 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 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 Email: suvpaca@ucalgary.ca. SU Faculty Rep., Phone: 403-220-3913 Email: sciencerep@su.ucalgary.ca. Student Ombudsman, Email: 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.

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 Learning Incomes

Trigonometry, geometry, algebra, basic calculus (derivatives and integrals), and high-school-level physics.
Basic understanding of data analysis, significant figures, error analysis, basic data plotting tools, familiar with VPython

Syllabus

1. Electric field

- Electric field and charge
- Structure of atoms
- Concept of electric field
- Electric field due to a charged particle
- Superposition of electric fields
- Electric field of a dipole
- Is electric field real?
- Computational modeling

2. Electric fields and matter

- Charge particles in matter
- How objects become charged
- Polarization of atoms, insulators and conductors
- Charged motion in metals
- Charge transfer
- Measuring electric field

3. Electric field of distributed charges

- Charged thin rod, thin ring, disk
- Two uniformly charged disks: A capacitor
- Spherical shell of charge, solid sphere
- Infinitesimals and integrals in science

4. Electric potential

- Systems of charged particles
- Potential difference in an electric field
- Sign of the electric potential
- Path independence
- Potential at one location
- Potential difference in and insulator
- Energy density and electric field
- Potential of distributed charges, spherical shell, solid sphere

5. Magnetic field

- Current
- Biot-Savart law for a moving charge, currents, loop of wire
- Magnetic dipole moment
- Magnetic field of a bar magnet
- Magnetic field of a solenoid

6. Electric field and circuits (time permitting)

- currents in different parts of the circuit
- Surface charge distribution
- Resistors
- Energy in a circuit
- Detecting surface charge

7. Circuit elements (time permitting)

- Capacitors
- Resistors
- Work and power in a circuit
- Multimeters
- RC circuits

8. Magnetic force

- Magnetic force on a moving charge, current carrying wire
- Combining electric and magnetic forces
- Hall effect
- Magnetic torque
- Potential energy for magnetic dipole

9. Patterns of field in space

- Gauss's law
- Electric flux
- Gauss's law for magnetism
- Ampere's law
- Differential form of Gauss's law
- Differential form of Ampere's law

10. Faraday's law

- Curly electric field
- Motional emf
- Inductance
- Lenz's rule

11. Electromagnetic radiation

- The Ampere-Maxwell law
- Maxwell's equations
- Accelerated charge (time permitting)

Course Outcomes:

- Solve basic problems using the concepts of electric and magnetic field, the associated forces, and the electric potential.
- Solve basic problems using Gauss’s Law, Faraday’s Law and Ampere’s Law
- Explain how Maxwell’s equations describe electro-magnetic radiation
- Recognize how the basic principles of electro-magnetism apply in a laboratory setting
- Apply mathematical techniques including vectors, derivatives and path integrals to physical problems
- Make physically motivated approximations.

Department Approval: Electronically Approved Date: 2019-01-06 14:18