COURSE OUTLINE

1. **Course:** PHYS 457, Electromagnetic Theory III - Winter 2021

   Lecture 01: MWF 13:00 - 13:50 - Online

   **Instructor**
   Dr. Eric Donovan

   **Email**
   edonovan@ucalgary.ca

   **Phone**
   403 220-6337

   **Office**
   SB 638

   **Hours**
   TBA

   **Instructor Email Phone Office Hours**

**Online Delivery Details:**

This course is being offered online in real-time via scheduled meeting times, you are required to be online at the same time.

To help ensure Zoom sessions are private, do not share the Zoom link or password with others, or on any social media platforms. Zoom links and passwords are only intended for students registered in the course. Zoom recordings and materials presented in Zoom, including any teaching materials, must not be shared, distributed or published without the instructor’s permission.

This course has a registrar scheduled, asynchronous final exam. The writing time is 2 hours + 50% buffer time, but the exam can be written any time in a 24-hour window.

Lectures to be delivered online via Zoom.

**Course Site:**

D2L: PHYS 457 L01-(Winter 2021)-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:

<table>
<thead>
<tr>
<th>Component(s)</th>
<th>Weighting %</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Class tests</td>
<td>40</td>
<td>All dates TBD</td>
</tr>
<tr>
<td>Assignments</td>
<td>20</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Class Participation</td>
<td>10</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30</td>
<td>Scheduled by the Registrar</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Minimum % Required</th>
<th>A+</th>
<th>A-</th>
<th>B+</th>
<th>B-</th>
<th>C+</th>
<th>C-</th>
<th>D+</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 %</td>
<td>90 %</td>
<td>85 %</td>
<td>80 %</td>
<td>75 %</td>
<td>70 %</td>
<td>67 %</td>
<td>63 %</td>
<td>60 %</td>
</tr>
</tbody>
</table>

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This course will have a final exam that will be scheduled by the Registrar. The Final Examination Schedule will be published by the Registrar’s Office approximately one month after the start of the term. The final exam for this course will be designed to be completed within 2 hours.

The final exam will be administered using an on-line platform. Per section G.5 of the online Academic Calendar, timed final exams administered using an on-line platform, such as D2L, will be available on the platform where the additional time will be added to the beginning of the registrar scheduled exam. E.g. If an exam is designed for 2 hours and the final exam is scheduled from 9-11am in your student centre, the additional time will be added to the start time of the exam. This means that if the exam has a 1 hour buffer time,

- the latest you should start an asynchronous exam would be 8 am in order to be able to submit the exam at 11am and have the full 3 hours.

4. Missed Components Of Term Work:

The university has suspended the requirement for students to provide evidence for absences. Please do not attend medical clinics for medical notes or Commissioners for Oaths for statutory declarations.

In the event that a student legitimately fails to submit any online assessment on time (e.g. due to illness etc...), please contact the course coordinator, or the course instructor if this course does not have a coordinator to arrange for a re-adjustment of a submission date. Absences not reported within 48 hours will not be accommodated. If an excused absence is approved, then the percentage weight of the legitimately missed assignment could also be pro-rated among the components of the course.

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.

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam/Camera (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Stable internet connection.

For more information please refer to the UofC ELearning online website.

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 Services:** For more information, see www.ucalgary.ca/wellnesscentre or call 403-210-9355.

   c. **Sexual Violence:** 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. The complete University of Calgary policy on sexual violence can be viewed at (https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf)

   d. **Misconduct:** Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Research integrity, ethics, and principles of conduct are key to academic integrity. Members of our campus community are required to abide by our institutional Code of Conduct and promote academic integrity in upholding the University of Calgary’s reputation of excellence. Some examples of academic misconduct include but are not limited to: posting course material to online platforms or file sharing without the course instructor’s consent; submitting or presenting work as if it were the student’s own work; submitting or presenting work in one course which has also been submitted in another course without the instructor’s permission; borrowing experimental values from others without the instructor’s approval; falsification/fabrication of experimental values in a report. Please read the following to inform yourself more on academic integrity:

      Student Handbook on Academic Integrity
      Student Academic Misconduct Policy and Procedure
      Research Integrity Policy

   Additional information is available on the Student Success Centre Academic Integrity page

   e. **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.

**f. 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.

**g. 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: ombuds@ucalgary.ca.

**h. 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.

**i. 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.

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**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
- 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 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. Assignments 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 up to a 20% reduction will be applied at the discretion of the instructor).

2. Class Participation Due: Most class periods Value: 10%

   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: dates to be determined, during class Value: 40%

   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
Electronically Approved - Jan 11 2021 10:16

**Department Approval**

- 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.