PHYS 216: Introductory Electricity and Magnetism

Where:	Engineering and Computer Science (ECS), Room 108	Instructor:	Prof. Thomas E. Baker
When:	TWF 11h30-12h20	Office:	Elliott Bldg., Rm. 118
Office hours:	W 12h30-13h20, unless shifted	Courriel:	bakerte (at) uvic [dot] ca
Midterm:	October 18, 2023 during regular class time	Final:	When announced

Catalog description.– Electric and magnetic fields, Gauss' law, electric potential, capacitance, dielectrics, current and resistance, resistivity, magnetic inductance. Faraday's law of induction, Ampère's law, energy stored in electric and magnetic fields.

Pre-requisites.– The previous requirements from physics courses are

- PHYS 110 - Introductory Physics I and PHYS 111 - Introductory Physics II
- or; PHYS 120 - Physics I and PHYS 130 - Physics II

An additional math class is a second requirement:

- MATH 200 - Calculus III

Content.– This course is an introduction to the forces of electricity and magnetism. The course will derive several expressions from physically evident phenomena and interpret those expressions to describe what is observed.

The order of the topics to be covered will be to cover electromagnetism in the vacuum and then the interaction with matter. We will conclude with a discussion of the basic elements of electronics and how to manipulate electromagnetism with basic circuits.

1. Review of calculus, vector calculus and units; motivation from gravitational forces (*Pre-requisites*)
2. Electric fields, fluxes, and scalar potentials; Laplace's and Poisson's equation, Gauss's law, Stokes' theorem, and Helmholtz's theorem (*Chap. 1-2*)
3. Magnetic fields and vector potentials; Lorentz forces, Ampère's law, Biot-Savart law (*Chap. 6*)
4. Wave equations; Faraday's law, energy stored in waves and the Poynting vector and radiation (*Chap. 9*)
5. Interactions of electric and magnetic fields with matter; scattering, Drude model, conductors, currents, dielectrics, capacitors, resistors, inductors, wave guides, continuous media (*Chap. 3-4, 7, 10, 11*)
6. Conservation of charge, resistors, and basic electric circuits; Ohm's law and Kirchoff's loop laws, Alternating-current (*Chap. 4, 8*)
7. Fields of moving charges (*Chap. 5*)

There is a laboratory and tutorial course which you will need to follow all applicable policies for. The end result will be to cover all chapters in the book *Electricity and Magnetism* by Edward M. Purcell and David J. Morin, 3rd edition. The book is not required, but it does contain some descriptions that are well regarded in the community. As the discussion will be out of order as presented in the text, I will make my notes available to the class. The major departure from the book is the development of electricity and magnetism independent of matter and then a discussion of how they interact with metals, insulators, and other materials which may not be familiar to everyone. This will mostly focus the discussion on the science instead of the particulars of who developed it.

One book you may consider purchasing is *Introduction to Electromagnetism* by David J. Griffiths. I also recommend *Classical Electricity and Magnetism: Second Edition* by Wolfgang Panofsky and Melba Phillips. The standard graduate text in the field is *Classical Electrodynamics* by John David Jackson. Jackson has generally good text, but it requires a high math barrier to truly appreciate; the problems in this text are legendary. One of the greatest book series, and some of the most complete texts, are those authored by Landau and Lifshitz. For this class, the relevant text is *The Classical Theory of Fields*, although there is a full series of introductory texts. Many great physicists have been made reading these, but they are tough. Give yourself time and be patient with yourself if you attempt these texts, perhaps budgeting time for more than one reading. However, they are well worth the effort.

Evaluation.– The final course evaluation will be derived from three main areas and weighted as laboratory (25%), homework (25%), midterm (20%), and final (30%). Partial correction will be allowed on the midterm and will contain a take-home portion. Homework is due by 23h59 on the due date, announced on each assignment. Grades will be assigned according to the university's chosen system based on the intervals (in interval notation):

F [0,50), D [50,60), C [60,65), C+ [65,70), B- [70,72), B [73,76), B+ [77-80), A- [80-85), A [85-90), A+ [90,100]

Attendance and collaboration.– You are welcome to work collaboratively on assignments. Please indicate the name of anyone you communicate with at the top of your assignment. Please also list what textbooks you are working from or any virtual resources including machine learned resources. Solutions will be posted once all assignments are entered and homework will be returned promptly.

There is no attendance taken in class. However, due to the non-linear structure of the course with the textbook, it is strongly encouraged. Lectures are not recorded unless with explicit written permission from myself in advance.

This remaining material contains university policy related to all courses.

I. EQUITY, DIVERSITY, AND INCLUSION (EDI)

Physics has been tragically plagued by narrow demographics over its lifespan. Everyone deserves an equal chance to understand the material and participate in class. The course will eschew a personal account of the scientists who developed the ideas here with a few notable exceptions. Rarely are past scientists heroes, but the scientific concepts are worth studying and building upon in your own career and be free to act in a manner better than history.

UVic's policy statement on EDI is found here and further acknowledgement here both of which I support fully.

II. ACADEMIC INTEGRITY

Students are responsible for understanding the core content of the course and to demonstrate that they have synthesized the material in all their courses. You are responsible for academic work that you submit or work on with others. You are expected to adhere to the ethical values of honesty, trust, fairness, respect and responsibility. This means not cheating, plagiarizing, falsifying materials, using an unauthorized editor or acting in other academically dishonest ways. Please note that you are responsible for unintentional plagiarism. This would include if an answer is derived from a machine learning or related model. If you are unfamiliar with plagiarism, then please take time to read the university's policy here. I reserve the right to use plagiarism detection software or other platforms to assess the integrity of student work.

Note that I have a mandatory reporting requirement for academic integrity and other unpleasant issues such as harassment. These limitations on your conduct are vital to ensuring you are properly educated and is justified historically and morally. Please consider using the wealth of resources available before choosing a less honest path.

III. ACADEMIC ACCOMMODATIONS AND CONCESSIONS

There are two major types of issues you may face during the course, requiring an accommodation or concession.

You have a legal right to disabilities and long-term afflictions. If you need an academic accommodation then you must contact the Centre for Accessible Learning (CAL) here on campus. They will ask for medical documentation. I must be presented with a letter from CAL before making any changes to help you. Due to over-subscription of CAL's services, it is recommended that you pursue any arrangement like this as early as possible to ensure the documentation is properly put through.

If you experience a short-term issue during the course (*e.g.*, such as an illness to you or someone in your family) or major community obligation (*e.g.*, service in the armed forces, cultural obligation, or required attendance as an athlete representing UVic), then you may seek an academic concession to change, modify, or delay a requirement for the course. Some of these requests can be granted if they are minor. For major changes, additional approvals must be given by the Department Chair of Physics & Astronomy.

Note that there is a formal Request for Academic Concession (RAC) form that is available to you in those cases of major changes or if work will not be completed by the time course grades are submitted. If all course requirements are met, then you are not eligible for academic concession. If the format of the class needs to change for extenuating circumstances or changes in the syllabus must occur, I will give advanced notice. This would occur if, for example, a major global event occurs. More information and the official university policy can be found here.