

# Introductory Electromagnetism and Wave Motion

PHYS 1004 A / PHYS 1004 B / PHYS 1004 C

*Winter term 2023*

## Course Outline

### Course description and prerequisites

This calculus-based course provides an introduction to various electricity and magnetism phenomena with emphasis on mastering the physics concepts required by students in the engineering programs. We will cover the electric and magnetic potential energy, electric and magnetic fields, forces and potentials, magnets, electromagnetic induction, electric circuits and electromagnetic waves. References to many applications and real-world examples will be used frequently. The associated laboratory and tutorial sessions alternate each week, and provide an essential complement to the lectures. Student evaluations will be based on labs, tutorials and quizzes, in addition to a final exam which is formally scheduled. Students are required to obtain a satisfactory grade in the laboratory component as well as overall to pass this course.

This course is intended for students who have already taken MATH 1004, ECOR 1101 or ECOR 1053, or ECOR 1045 and ECOR 1046 (which may be taken concurrently), or PHYS 1001 or PHYS 1003 or PHYS 1007 (with the additional requirement of having obtained at least B- in PHYS 1007), or *with explicit permission from the Physics Department*

**Note:** *Lectures, discussions and office meetings are three hours per week; and laboratory, or tutorial sessions are an additional three hours per week. In addition, students are expected to read selected chapters in the textbook and exercise, including by solving the required homework assignments.*

## Instructors and contact information

Alain Bellerive	PHYS 1004 section A instructor	alainb@physics.carleton.ca
Wafia Bensalem	PHYS 1004 section B instructor	wafiabensalem@cunet.carleton.ca
Razvan Gornea	PHYS 1004 section C instructor	razvangornea@cunet.carleton.ca
Jesse Lock	Lab & tutorial groups coordinator	jesselock@cunet.carleton.ca

Each student has access to two Brightspace websites, one for the lectures and another one for the labs and tutorials. For the second, it is very important that each student identifies at the start of the term the appropriate lab & tutorial group. Office hours are posted on the respective Brightspace websites. All the lecture recordings, slides and links to various interactive sessions, are posted in the appropriate lecture section, along with additional course information. Both Brightspace websites should be consulted carefully and frequently.

*All email communications must be done from your Carleton University account. Email early about any possible issue regarding this course work and grades, and please keep copies of all exchanges until the end of the term.*

*To get access to your Carleton Email you will need to activate your MyCarletonOne account through Carleton Central. Once you have activated your MyCarletonOne account, log into the MyCarleton Portal.*

## Textbook

**Fundamentals of Physics**, 12th Edition, **Halliday, Resnick & Walker**, John Wiley & Sons Canada Ltd.

The textbook can be bought (or rented) at the [Carleton bookstore](#).

## Course philosophy and objectives

*Physics provides the ideal opportunity to learn the art of quantitative thinking, i.e. learning how to successfully turn an abstract concept into a concrete calculation or measurement. In order to solve any problem, you must critically examine the information available in a given situation; determine an effective method to obtain the solution and carry through with confidence, including a critical examination of the final answer. These skills will serve you throughout your future career. This course is a good step towards that end. The goal of physics is to understand the physical universe and be able to accurately describe and predict what is observed. Physics is based on such critical thinking, and hence helps to develop independence and free thinking. An understanding of physics helps you perceive the world around you in a more comprehensible, enjoyable, and fascinating way. That being said, learning physics is not a spectator sport. To learn physics, the you must do work outside of class thinking about, and interacting with, the*

course material. ***No one ever learns physics by simply reading about it or listening to someone talk about it. You learn by making the effort to understand the course material and by solving problems using the principles learned.*** The standard at university is that you spend one hour outside of class for every hour in class.

## Course delivery

This course is delivered in person as a mixture of lectures, tutorials, labs, discussions and office hours, as well as asynchronous activities (recordings, slides and quizzes). The specific dates and activities are described below. The asynchronous activities are intended to provide flexibility to students. Students are expected to remain up to date with the deadlines and due dates as provided by the instructors. In practice, this course requires Internet access and a computer.

Lectures in this course will be recorded on Zoom and made available on Brightspace. Sessions are recorded to enable access occasionally for students based in a different time zone or have conflicting commitments. If remote students wish not to be recorded, they need to leave their camera and microphone turned off. Students will be notified at the start of the session when the recording starts. ***Please note this is not a remote course and in-person attendance for labs and tutorials is mandatory.***

Also, please note that course materials and recordings are protected by copyright. These are for your own educational use, but you are not permitted to publish to third party sites, e.g. social media sites or specific course material web sites. ***All solutions and answers to any quiz or exam in this course must be your own work.***

## Lectures

This course is divided into 12 modules, that each covers a three-hour traditional lecture. The recordings will be divided into two sessions following the weekly lecture schedule. In addition, each instructor delivers synchronous office hours via Zoom or BigBlueButton, or in-person, every week according to the schedule of the respective section, as described on Brightspace (or, optionally, on demand). Below is the list of the topics that will be covered within each lecture module and the corresponding textbook sections recommended for further reading.

Module	Subject	Textbook chapter	Quiz due
1	Electrostatics ( <i>week of Jan 9</i> )	<b>Chap 3:</b> Vectors <b>Chap 21:</b> Coulomb's Law	Jan 16
2	Electric field due to discrete charges ( <i>week of Jan 16</i> )	<b>Chap 22:</b> Electric Fields (part I)	Jan 23
3	Electric field due to continuous charge distributions ( <i>week of Jan 23</i> )	<b>Chap 22:</b> Electric Fields (part II)	Jan 30
4	Gauss' law ( <i>week of Jan 30</i> )	<b>Chap 23:</b> Gauss' Law	Feb 6
5	Work and energy ( <i>week of Feb 6</i> )	<b>Chap 7:</b> Kinetic Energy and Work <b>Chap 8:</b> Potential Energy and Conservation of Energy <b>Chap 24:</b> Electric Potential Energy	Feb 13
6	Electric potential ( <i>week of Feb 13</i> )	<b>Chap 24:</b> Electric Potential	Feb 27
<b>Reading week</b>			
7	Capacitance ( <i>week of Feb 27</i> )	<b>Chap 25:</b> Capacitance	Mar 6
8	Magnetic fields ( <i>week of Mar 6</i> )	<b>Chap 28:</b> Magnetic Fields <b>Chap 29:</b> Magnetic Fields due to Currents	Mar 13
9	Induction ( <i>week of Mar 13</i> )	<b>Chap 30:</b> Induction and Inductance	Mar 20
10	AC circuits ( <i>week of Mar 20</i> )	<b>Chap 31:</b> EM Oscillations and Alternating Current	Mar 27
11	Maxwell's equations ( <i>week of Mar 27</i> )	<b>Chap 32:</b> Maxwell's Equations	Apr 3
12	Electromagnetic waves ( <i>weeks of Apr 3 and Apr 10</i> )	<b>Chap 33:</b> Electromagnetic Waves	Apr 14

## Weekly quizzes

Each week, there is a quiz administered through Brightspace. These are due at the beginning the week following the conclusion of each module (that is Mondays at midnight). You have two attempts to complete each quiz, and plenty of time to complete each attempt (two hours), but please note that your work will count even if you would exceed this time.

***The best 10 of 12 quizzes will count towards your final mark.***

***If there is any discrepancy between the marks posted on Brightspace and your calculated values notify the instructor immediately.***

## Numerical Answers

When answering the assignment questions requiring a calculation enter the answer when appropriate in scientific notation with three significant figures, e.g.  $1.60 \times 10^{-19}$ . You are allowed a 5% variance between your answer and the one calculated within Brightspace to account for rounding errors. If the question explicitly asks for a different number of significant figures or demands an answer with a certain number of digits of precision then please follow those specific instructions. Otherwise, if the significance or the accuracy of the answer deviates

from the stated ranges, the question or problem will be marked as incorrect. Answers of this sort will not be eligible for reassessment by the instructors.

Ensure to always take careful note of the units of your answer, typically it is expected that the answer will follow SI units (e.g. m, s, J) however there are occasions in which non-standard units will be required for specific questions. Generally, these instances will be noted in the question itself, e.g. "Express your answer in km". Units are not to be entered with the numerical answer for these assignments.

## Labs and tutorials

*All labs and tutorials will be held in person. No online alternatives will be offered for any circumstances.*

Labs and tutorials start the week of **January 9, 2023** with an introduction and calculus review. *It is imperative that all students attend the first lab session!* You can attend only the section that you are registered in. *All the changes (e.g. exemptions) must be arranged with the Lab Coordinator, Mr. Jesse Lock at the start of term.* Students who might be exempt from the Lab (if they are repeating the course, for example) must contact the Lab Coordinator. You are not automatically given a lab exemption - you must apply for it no later than **January 27th**. Lab exemptions will be considered on a case-by-case basis at the discretion of the Lab Coordinator.

The grade for every lab will be based on an in-class lab write-up. All lab work (write-ups) counts towards your total lab grade for the course. *No grade will be dropped.* All lab write-ups must be completed and submitted by the end of each lab session. *No lab work will be accepted for grading outside of the lab.*

*If you miss a lab, contact Mr. Jesse Lock (or your lab supervisor) immediately.*

Lab #	Title	Deadline for report	Weight (%)	Week of
1	<i>Electrostatics</i>	End of the lab	20	January 16, 2023
2	<i>DC Circuits</i>	End of the lab	20	January 30, 2023
3	<i>Magnetic Balance</i>	End of the lab	20	February 13, 2023
4	<i>Oscilloscope</i>	End of the lab	20	March 6, 2023
5	<i>RC &amp; RLC Circuits</i>	End of the lab	20	March 20, 2023

***There will be a tutorial on each alternating week with the labs.*** The structure of the tutorial is as follows.

A set of tutorial problems will be posted on the lab/tutorial Brightspace website at least a week before the tutorial session. Students should attempt to solve all these problems in order to prepare for the tutorial. At the start of the tutorial session the instructor will go through a new problem that you have not seen before on the board. Then the TAs will demonstrate solving the practice problems and answering questions about the tutorial problem set. The last hour of the tutorial will be an close-book test consisting of two multiple choice problems and one long-answer problem (i.e. the tutorial test has a 60 minutes duration).

The grade for the tutorial test and the multiple-choice quiz will be combined to provide the final Tutorial Test grade for each of the 5 tutorial sessions this semester.

***The four highest test grades will be used to determine the final Tutorial Test score.***

Students must attend the tutorial only in the lab section to which they belong. Exceptionally, to be able to attend a different section, students must obtain permission from the lab coordinator **Mr. Jesse Lock (jesselock@cunet.carleton.ca)**. Such permission will usually be granted only for emergencies or medical reasons. If you cannot attend your own lab section one week due to e.g. medical reasons, let us know **AS SOON AS POSSIBLE** so that you can be rescheduled to a different section.

## **Final Exam**

***There is no mid-term examination in this course.*** We regard the five tutorial tests, and the homework assignments, as the main avenues for providing performance feedback and guidance to the students in this course. ***If you do not perform to your own satisfaction, it is imperative to discuss this with your instructors during office hours or by email. Do not leave this consultation until the end of the course.*** Effective assistance is best obtained sooner than later.

The final examination will be formally scheduled during the regular April final exam period and announced toward the end of the term. ***It is the responsibility of the students to be present during the final exam period; in particular, holiday travel arrangements must not be made before the final exam date is known. The final exam may include questions related to the material contained within the lab portion of the course.***

## Grade distribution

Weekly quizzes (best 10 out of 12)	15%
Tutorials (best 4 out of 5)	25%
Labs (all 5 count)	35%
Final examination	25%
<b>TOTAL</b>	<b>100%</b>

*Attending all labs and tutorials is mandatory. Also, students must obtain at least 50% of the lab component, as well as at least 50% on the theory component (weekly quizzes, tutorials and final exam), in order to pass this course.*

## University policies

### ***Academic Regulations, Accommodations, Plagiarism***

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

<http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/>

### ***Academic Accommodations for Students with Disabilities***

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation.

If you are already registered with the PMC, contact your PMC coordinator to send your *Letter of Accommodation* at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (*if applicable*).

<https://carleton.ca/pmc/>

### ***For Religious Obligations***

Students requesting academic accommodations on the basis of religious obligation should make a formal, written request to their instructors for alternate dates and/or means of satisfying academic requirements. Such requests should be made during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist, but no later than two weeks before the compulsory event.

Accommodation is to be worked out directly and on an individual basis between the student and the instructor(s) involved. Instructors will make accommodations in a way that avoids academic disadvantage to the student.

Students or instructors who have questions or want to confirm accommodation eligibility of a religious event or practice may refer to the Equity Services website for a list of holy days and Carleton's Academic Accommodation policies, or may contact an Equity Services Advisor in the Equity Services Department for assistance.

### ***For Pregnancy***

Pregnant students requiring academic accommodations are encouraged to contact an Equity Advisor in Equity Services to complete a letter of accommodation. The student must then make an appointment to discuss her needs with the instructor at least two weeks prior to the first academic event in which it is anticipated the accommodation will be required.

***Survivors of sexual violence:*** *As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit [carleton.ca/sexual-violence-support](http://carleton.ca/sexual-violence-support).*

***Accommodations for student activities:*** *Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see [the policy](#).*

*You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at [carleton.ca/equity/](http://carleton.ca/equity/).*

### ***Plagiarism***

Plagiarism is the passing off of someone else's work as your own and is a serious academic offence. For the details of what constitutes plagiarism, the potential penalties and the procedures refer to the section on Instructional Offences in the Undergraduate Calendar.

### ***What are the Penalties for Plagiarism?***

A student found to have plagiarized an assignment may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; and/or a reprimand; a refusal of permission to continue or to register in a specific degree program; academic probation; award of an FNS, Fail, or an ABS.



Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy (see <https://carleton.ca/registrar/academic-integrity/>). The Policy is strictly enforced and is binding on all students. Plagiarism and cheating – presenting another’s ideas, arguments, words or images as your own, using unauthorized material, misrepresentation, fabricating or misrepresenting research data, unauthorized co-operation or collaboration or completing work for another student – weaken the quality of the graduate degree. Academic dishonesty in any form will not be tolerated. Students who infringe the Policy may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; a refusal of permission to continue or to register in a specific degree program; academic probation; or a grade of Failure in the course.

***Assistance for Students***

Academic and Career Development Services: <http://carleton.ca/sacds/>

Writing Services: <http://www.carleton.ca/csas/writing-services/>

Peer Assisted Study Sessions (PASS): <https://carleton.ca/csas/group-support/pass/>

Math Tutorial Centre: <https://carleton.ca/math/math-tutorial-centre/>

Science Student Success Centre: <https://sssc.carleton.ca/>