

PHYS 2903 - Winter 2025 - Physics Towards the Future

We, the people of the Faculty of Science at Carleton University, acknowledge that our campus is located on the traditional, unceded territories of the Algonquin Anishinabeg people. Miigwetch for your hospitality and stewardship of this territory and the teachings that come from it. We are grateful for this land, the air that we breathe, and the water that sustains us all as well as for the animals, plants and other living beings: these enable us to research, teach, mentor, support, study, and learn. We recognize our responsibility to our natural environment and to reconciliation with Indigenous peoples.

Course Instructor: Kevin Graham

How to address me: Professor Graham

Email: Kevin_Graham@Carleton.ca

Student Hours: To set up an appointment, please send me an email with the **subject 'PHYS 2903'**. Appointments can be via zoom or in-person.

Office Location: Room 3322, Herzberg Building

Class Location: online only

Class Times: not applicable

Prerequisites: 2nd-year standing

Preclusions: none

Department/Unit: Physics

Topics Covered and Learning Outcomes

This course is intended for students with little or no background in Science. It introduces physics through a set of modules that closely connect to our everyday life and future. This course is only available on-line via BrightSpace and is delivered asynchronously (i.e., it does NOT have fixed lecture times). Students should complete the online lessons following the course timeline (starting on Page 3). The lectures are interactive and include questions. Students are required to achieve 75% or higher in a lecture before they can take the next lecture. **All lectures must be completed to gain access to the module quizzes.**

By the end of the course, students should be able to:

1. Explain physics related phenomenon using basic physics principles and terminology
2. Perform basic calculations/estimations to solve simple physics related problems
3. Make correct judgements/decisions on physics related issues in their daily life based on basic physics principles
4. Explain our position in the solar system, our galaxy and the universe
5. Briefly describe a couple recent advances in physics research

Reference Material

This course does not require a textbook. However, if you would like further reading, you can have a look at “Physics Beyond the Comfort Zone” by Peter Watson. The book covers some basic physics such as mechanics, kinematics, heat and energy and electromagnetism. It also covers physics of sound and light. It is available at <https://books.apple.com/ca/book/physics-beyond-the-comfort-zone/id902018641> for a cost of \$9.99.

Topics Covered

The following thematic modules will be covered in this course. Each module will help you answer a series of questions listed below.

1. Sound and Music

In many ways, music might be viewed as one of the most human of inventions. What is the nature of sound and what are the relationships between pitch, loudness, musical scales and the fundamental properties of sounds? How are sounds generated, from different types of instruments, that create a musical performance?

2. Light and Colour

What is light exactly? What is radiation and electromagnetic wave? How do eyes and lenses work? How do we see colours? How do we communicate with EM waves?

3. Cell Phone

It has become commonplace, almost anywhere one travels in the world, to see people using cell phones for conversations, texting, accessing the internet, listening to music, and taking photos. What are the physics principles behind the manufacture and operation of cell phones?

4. Medical Physics

Medical physics is about using physical approaches to diagnose and treat diseases. What is x-ray? How does it “see” through our body? What is MRI? Why do doctors always order MRI instead of x-ray if you have a joint pain? How ultrasound scan works?

5. The Solar System and Beyond

The nature of the universe beyond our planet has always fascinated humans. How do we use rockets to place satellites in orbit and send missions out into the solar system? What is the structure of our solar system...of our galaxy...of the universe?

6. Recent Advances

Some of the most interesting questions in science are being tackled by physicists around the world. What are dark matter and dark energy? What are gravitational waves? Why is discovery of the Higgs particle important and what does it tell us? What are neutrinos and how do we observe them?

The pace of this course is approximately completing one module in every two weeks. The following is the timeline.

Thematic Modules	Suggested completion dates of lecture videos	Physics topics covered
1. Sound and Music	January 13	amplitude, velocity, wavelength, and frequency of sound waves, resonance, interference, harmonics, standing waves
2. Light and Colour	January 27	radiation as wave, electromagnetic wave, optical lenses and its application, human eyes, wavelength and color, color perceptions, radio waves and communication.
3. Cell Phone	February 10	semiconductors, diode and transistor, basic of logic gates and CPU, fabrication of integrated circuits, acceleration and accelerometer, rotation and gyroscope, light polarization and LCD screen.

4. Medical Physics	February 24	x-ray properties and production, x-ray diffraction and imaging, ionizing radiation dose, radiation therapy, linear accelerators, accurate delivery of radiation, nuclear magnetic resonance, magnetic resonance imaging principle and safety, ultrasound and its production, reflection of US, B-mode US imaging.
5. Solar System	March 10	gravity, momentum, energy, circular motion, orbits, time dilation
6. Recent Advances	March 25	neutrinos, Higgs particle, gravitational waves, dark energy and dark matter

Quiz Due Dates

The quizzes which will be accessed on Brightspace, will be available for 1 week before the due date, and require students to complete the corresponding module before being available.

Note: students must complete each quiz before the deadline or a grade of zero will be assigned.

Thematic Module	Module Quiz due date
1. Sound and Music	January 17, 23:59 pm
2. Light and Colour	January 31, 23:59 pm
3. Cell Phone	February 14, 23:59 pm
4. Medical Physics	February 28, 23:59 pm
5. Solar System	March 14, 23:59 pm
6. Recent Advances	March 29, 23:59 pm

Lab and Essay Due Dates

Each thematic module has suggested essay topics and/or a lab you can perform using materials or devices that are available in your home. You are required to write one essay and one lab report, each on a different topic of the topics available. The lab must be chosen from the first two thematic Modules (Sound and Music or Light and Colour). The essay must be chosen from the last four modules (Cell Phone, Medical Physics, Solar System and Beyond, or Recent Advances) (**see next page for due dates**).

	Thematic Module	Due date
Lab	Sound and Music or Light and Colour	March 7, 23:59
Essay	one from Cell Phone Medical Physics Solar System Recent Advances	April 8, 23:59

Final Exam

The final exam will be available in Brightspace. Students will have 2-hours to complete the exam once started. The exam will be available to start during the first 2 weeks of the exam period.

Assessments

Grade Breakdown

COMPONENT	GRADE VALUE
QUIZZES	25%
LAB	25%
ESSAY	25%
FINAL EXAM	25%

All graded components must be completed to pass the course.

Use of AI tools for completion of graded components of this course is prohibited.

Late and Missed Work Policies

Late or Missed Work

All work must be completed on time for this course. Late or missed work will receive a grade of zero. If a student misses a course deadline, for some valid, documented reason, they must contact the professor.

Copyright Statement

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copyright protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s). Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

Academic Accommodations and Regulations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (<https://students.carleton.ca/course-outline/>).

Statement on Chat GPT/Generative AI usage

As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of AI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.

Statement on Academic Integrity

Students are expected to uphold the values of academic integrity, which include fairness, honesty, trust, and responsibility. Examples of actions that compromise these values include but are not limited to plagiarism, accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using artificial intelligence tools such as ChatGPT when your assessment instructions say it is not permitted.

Misconduct in scholarly activity will not be tolerated and will result in consequences as outlined in [Carleton University's Academic Integrity Policy](#). A list of standard sanctions in the Faculty of Science can be found [here](#).

Additional details about this process can be found on [the Faculty of Science Academic Integrity website](#).

Students are expected to familiarize themselves with and abide by [Carleton University's Academic Integrity Policy](#).

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the [7 Rights and Responsibilities Policy](#) for details regarding the expectations of non-academic behaviour of

students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is the professor:** Email Professor Graham with the subject line ‘PHYS 2903’ and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

Note:

