

## PHYS 5204 Winter 2025

### Physics of Medical Imaging

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.

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**Course Coordinator:**

Avery Berman ([avery.berman@carleton.ca](mailto:avery.berman@carleton.ca))

**Additional Lecturers:**

Bog Jarosz ([Jarosz@physics.carleton.ca](mailto:Jarosz@physics.carleton.ca))

Rob de Kemp ([radekemp@ottawaheart.ca](mailto:radekemp@ottawaheart.ca))

Glenn Wells ([radekemp@ottawaheart.ca](mailto:radekemp@ottawaheart.ca))

Tong Xu ([txu@physics.carleton.ca](mailto:txu@physics.carleton.ca))

**Office Location:** Herzberg 2420

**Class Location:** Please check Carleton Central for the room location.

**Class Times:** Mon & Wed, 10:05–11:25 AM

**Prerequisites:** PHYS 5203 or equivalent and PHYS 4203/5313 or equivalent

**Best ways to be in touch:** in class or via email

**Student Hours:** by appointment

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## Topics Covered and Learning Outcomes

Several instructors will deliver the course content, each an expert in their own imaging domain.

Week	Topic/Content	Instructor	Readings/Prep for Class
1	Introduction & X-ray production	Berman	Ch. 5 (from Dance <i>et al.</i> )
2	X-ray projection imaging	Berman	Ch. 6
3	Physics of X-ray detectors	Berman	Ch. 7
4	Applications (Mammography, Fluoroscopy, Angiography) & Detector performance metrics	Berman	Ch. 8, 9, 4
5	Linear Systems	Xu	Ch. 4
6	X-ray CT	Xu	Ch. 11
7	X-ray CT	Xu	Ch. 11
8	Nuclear Medicine	Wells	supplied by lecturer
9	SPECT & PET	Wells, de Kemp	supplied by lecturer
10	MRI	Berman	Ch. 14 + supplied by lecturer
11	MRI	Berman	Ch. 14 + supplied by lecturer
12	MRI & Ultrasound	Berman, Jarosz	Ch. 14, 12 + supplied by lecturer
13	Ultrasound	Jarosz	Ch. 12, 13 + supplied by lecturer

*Important dates and deadlines can be found here:*

<https://carleton.ca/registrar/registration/dates/academic-dates/>, including class suspension for fall, winter breaks, and statutory holidays.

### Course-level learning outcomes:

You should have a firm understanding of, be able to explain, and be able to perform calculations based on the principles that underlie the conventional diagnostic imaging modalities, including:

- hardware

- contrast mechanisms
- image reconstruction
- image quality, including spatial and temporal resolution, noise, etc.
- image artifacts
- use of contrast agents, where applicable
- safety issues

## Assessments

### Assignments & Project:

There will be 5–7 problem sets. Late assignments only be accepted in exceptional cases. Grading will, in part, be based on clarity, rigour, and organization of solutions.

There will be one project on a specific area of medical imaging, requiring a written report and presentation at the end of the term. Presentations will be scheduled outside of the regularly scheduled lectures, ideally sometime during April 8–10.

### Grade Breakdown

COMPONENT	GRADE VALUE
ASSIGNMENTS	40%
PROJECT	20%
FINAL EXAM	40%

## Late and Missed Work Policies

### Late Work

Late work will generally not be accepted.

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## Learning Material(s) and Other Course/Lab-Related Resources

Students are not required to purchase textbooks or other learning materials for this course. We do, however, recommend the following two textbooks for general content. The other instructors may provide handouts or other suggested readings.

Learning Material	Options for Purchasing	Approximate Cost
Dance, Christofides, Maidment, McLean, & Ng <i>Diagnostic Radiology Physics: A Handbook for Teachers and Students</i>	Available online from the IAEA: <a href="https://www.iaea.org/publications/8841/diagnostic-radiology-physics">https://www.iaea.org/publications/8841/diagnostic-radiology-physics</a>	Free

IAEA, 2014.		
Bushberg, Seibert, Leibholdt, Jr., & Boone <i>The Essential Physics of Medical Imaging</i> 4 <sup>th</sup> edition, Wolters Kluwer Health, 2020.	Available online from the Carleton library	Free

## 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:

The use of an AI chatbot is discouraged since, a) depending on how it is used, it could deprive you of the work of grappling with challenging concepts—an often necessary component of learning—b) you will not have the opportunity to use one on the midterm and final exam, and c) it could potentially be considered plagiarism, which is a violation of the Carleton Academic Integrity Policy (see later).

### 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 me:** Email or drop in during student hours 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:** You can also bring your concerns to Ombuds services.

