PHYS 5203: Fall 2025

Medical Radiation Physics

Class information

Modality: In-person
Class Times: Monday & Wednesday, 2:30 – 4 pm (eastern)
Class Location: Please check Carleton Central for current class location (click here for visual directions).
Prerequisites: Permission of the Department
Brightspace link: CourseURL

Course instructor

Name: Rowan Thomson (hear my name)
Gender pronouns: she/her
How to address me: Professor Thomson
Email: Rowan.Thomson@carleton.ca
Phone: (613) 520-2600 ext. 7540 (email is more reliable)
Office Location: Please see Brightspace.

Note: If you have or question or would like to talk with me, you can send an email, visit me during student hours (see below), or approach me after lecture.

Student Hours

Times: Monday & Wednesday, 1 – 2 pm
Location: My office.

What are 'Student Hours'? Student hours are dedicated times through the week for the course instructor and TAs to meet with YOU. Pop in to introduce yourself, ask questions about the course, or discuss content from the course. Note: If these If these times don't work for you, email me and we can arrange an alternate time to meet.

Welcome to this Course!

This course focuses on fascinating modern physics in the context of radiation medicine. Critically important to people's lives around the world, radiation medicine plays many roles from diagnosis to treatment. For example, 1/4 of Canadians are expected to undergo radiation treatment for cancer in their lifetime. We will be learning about the physics that plays a central role in all of this! You will need to remember your background in Modern Physics, particularly Special Relativity and Quantum Mechanics, plus Electricity and Magnetism.

Calendar entry: Interaction of electromagnetic radiation with matter. Sources: X-ray, accelerators, radionuclide. Charged particle interaction mechanisms, stopping powers, kerma, dose. Introduction to dosimetry. Units, measurements, dosimetry devices.

Course Level Learning objectives

1. Master the details of and be able to explain, be familiar with typical values concerning, and be able to perform calculations for and connecting:
    a. transfer of energy from radioactive decay to decay particles, photons, excited nuclear states, excited atomic states, and ultimately their relaxation via photon and electron emission
    b. kinetics of radionuclide decay chains, radioisotope generators
    c. interaction cross section concept and types - total, energy transferred, energy absorbed, expressed in linear terms, mass terms, atomic, electronic
    d. photon interactions with matter: photoelectric effect, incoherent scattering, coherent scattering, pair production, photonuclear absorption
    e. neutron interactions
    f. charged particle interactions with matter, description by stopping powers
    g. production of radiation by an x-ray tube
    h. production of radiation by linear accelerators, including overall machine design features
    i. production of radiation by isotope machines such as ^{60}Co
    j. penetration of photon and particulate radiation into matter, with concepts of buildup, backscatter, HVL
    k. introduction to kerma and dose, collision kerma, air kerma and exposure, and their units
    l. basic cavity theory, the concept of absolute dosimetry
    m. essentials of radiation protection, including dose equivalent and whole-body effective dose, medical exposures compared to annual background
2. Enhance and extend problem-solving skills in radiation physics by working through advanced multi-step problems using the tools of physics, calculus, algebra, and numerical analysis.
3. Become familiar with the general outline of the field of medical physics, its history, subfields, the Canadian context, Canadian and international scientific and professional organizations.

Inclusive Teaching Statement

Science is for everyone. I am committed to fostering an environment for learning that is inclusive for everyone regardless of gender identity, gender expression, sex, sexual orientation, race, ethnicity, ability, age, class, etc. All students in the class, the instructor, and any guests should be treated with respect during all interactions. It is my hope that our class will support diversity of experience, thought, and perspective. I will continually strive to create inclusive learning environments and would therefore appreciate your support and feedback. I welcome emails or in-person communications to let me know your preferred name or pronoun. Please see the Faculty of Science Equity, Diversity, and Inclusion (EDI) statement: https://science.carleton.ca/about/edi/

Territory Acknowledgement

We acknowledge that the land on which we gather and learn is the traditional and unceded territory of the Algonquin nation. You are invited to learn more (https://carleton.ca/indigenous/), reflect on how you can support anti-racism and decolonization, and take action.

Community Guidelines

The following values are fundamental to academic integrity and are adapted from Tricia Bertram Gallant, Ph.D, the International Center for Academic Integrity. In our course, we will seek to behave with these values in mind:

Honesty

As students, we will:

- Honestly demonstrate our knowledge and abilities on assignments and exams
- Communicate openly without using deception, including citing appropriate sources

As a teaching team, we will:

- Give you honest feedback on your demonstration of knowledge and abilities on assignments and exams
- Communicate openly and honestly about the expectations and standards of the course through the syllabus, and with respect to assignments and exams

Responsibility

As students, we will:

- Complete assignments on time and in full preparation for class
- Show up to class on time, and be mentally/physically present
- Participate fully and contribute to team learning and activities

As a teaching team, we will:

- Give you timely feedback on your assignments and exams
- Show up to class on time, and be mentally and physically present
- Create relevant assessments and class activities

Respect

As students, we will:

- Speak openly with one another, while respecting diverse viewpoints and perspectives
- Provide sufficient space for others to voice their ideas

As a teaching team, we will:

- Respect your perspectives even while we challenge you to think more deeply and critically
- Help facilitate respectful exchange of ideas

Fairness

As students, we will:

- Contribute fully and equally to collaborative work, so that we are not freeloading off others

- Not seek unfair advantage over fellow students in the course

As a teaching team, we will:

- Create fair assignments and exams, and grade them in a fair, and timely manner
- Treat all students equitably

Trust

As students, we will:

- Not engage in personal affairs while on class time
- Be open and transparent about what we are doing in class
- Not distribute course materials to others without authorization

As a teaching team, we will:

- Be available to all students when we say we will be
- Follow through on our promises
- Not modify the expectations or standards without communicating with everyone in the course

Courage

As students, we will:

- Say or do something when we see actions that undermine any of the above values
- Accept a lower or failing grade or other consequences of upholding and protecting the above values

As a teaching team, we will:

- Say or do something when we see actions that undermine any of the above values
- Accept the consequences of upholding and protecting the above values (for example, lower teaching evaluations.)

Generative AI use

AI Use in this course: Students may use AI tools for basic word processing and formatting functions, including:

- Grammar and spell checking (e.g., Grammarly, Microsoft Word Editor)
- Basic formatting and design suggestions (e.g., Microsoft Word's formatting tools, PowerPoint Design editor)

Documenting AI Use: It is not necessary to document the use of AI for the permitted purposes listed above. If you have questions about a specific use of AI that isn't listed above, please consult the instructor.

Why have I adopted this policy? This policy ensures that student voices and ideas are prioritized and authentically represented, maintaining the integrity of the work produced by

students while allowing basic support to enhance clarity, correctness, layout, and flow of ideas. The goal of adopting a limited use of AI is to help students develop foundational skills in writing and critical thinking by practicing substantive content creation without the support of AI.

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.

Citation of AI or ChatGPT use per APA guidelines listed on this webpage:
(e.g., OpenAI. (2023). *ChatGPT* (May 31 version) [Large language model]. https://chat.openai.com/chat)

Learning Materials

Textbooks

- **P. Andreo, D.T. Burns, A.E. Nahum, J. Seuntjens, & F.H. Attix,* ***Fundamentals of Ionizing Radiation Dosimetry ("FIORD")****, 2017*
- **E.B. Podgorsak,* ***Radiation Physics for Medical Physicists****, 3rd edition, 2016.*
- *P. Mayles, A. Nahum, J.C. Rosenwald (eds.), Handbook of Radiotherapy Physics: Theory and Practice, 2007 (or later edition).*
- *H.E. Johns & J.R. Cunningham, The Physics of Radiology, 4th edition, 1983.*
  C.J. Karzmark and R.J. Morton, A Primer on Theory and Operations of Linear Accelerators in Radiation Therapy, 2nd ed., Medical Physics Publishing, Madison Wisconsin, 1998.

**Will be referred to most heavily.*

Cost of textbook: Free because the books are available (as ebooks) from Carleton's MacOdrum library.

Technology Checklist:

- An internet-enabled computer (laptop/desktop)
- Access to reliable internet

Assessment in this Course

Research about learning strongly suggests that the most important factor in learning is doing the work of reading, writing, recalling, practicing, synthesizing, and analyzing. Learning happens best when people actively engage material on a consistent basis, and that is why we have high standards in this course. We are confident that, with appropriate effort, you **all** can meet those standards.

We also make an effort to reduce unintentional bias in grading by, for example and when possible, grading assignments one question at a time (grading all of question 1 before grading any of question 2), grading anonymously, and using rubrics.

Grade Breakdown

In-class participation – 12%

Assignments – 22%

Midterm test and oral interview – 24%

Final Exam – 30%

Final oral interview – 12%

Assignments

Assignments will be distributed roughly each week throughout the term and will generally be due in class 1 week after distribution. Late assignments will not generally be accepted. Students are permitted to discuss concepts and strategies related to solving the assignments; however, the work you turn in must be your own. The assignments are a critical part of the course and working through the problems yourself is essential to learn the material. Your homework solutions should be thorough, self-contained, and logical, with all steps explained. Assignments will also have components that will be presented by each student to classmates during class times.

Assignments will be posted and submitted on Brightspace. Hand-written solutions may be scanned or photographed for upload. A computer will be needed for graphing and some word processing. The complete assignment must be uploaded as a single PDF file.

The lowest 2 assignment grades will be dropped.

Midterm Test and Oral Interview

There will be one 70-minute test held in class, tentative date **Oct 8**.

There will be one 15-minute midterm oral interview scheduled 1-on-1, tentative date **Nov 12**.

- In the case of an exam deferral for legitimate reasons, please inform me within 24 hours of the regularly scheduled midterm to arrange a time to write the deferred exam.

Looking for help preparing for midterms? Centre for Student Academic Support at Carleton offers course-targeted study groups and supports and the Science Student Success Centre (SSSC) provides help with study skills.

Final Exam

The final exam will take place during the final exam period.

Oral interview

In addition to the final exam, a 20 minute oral interview with each student will take place during the final exam period.

Feeling Sick?

If you feel very sick (for example: fever, chills, stomach upset) do not come to class or campus.

Mental Health

If you are struggling, please do not hesitate to reach out. I am happy to listen, and/or direct you to resources that might help. In terms of class, if you need extra help or missed a lesson, don't stress! Email me and we will set a time to meet. Remember that Carleton also offers an array of mental health and well-being resources for you.

University Policies

In accordance with the Carleton University Undergraduate Calendar Regulations, the letter grades assigned in this course will have the following percentage equivalents:

A+ = 90-100%	A = 85-89%	A- = 80-84%
B+ = 77-79%	B = 73-76%	B- = 70-72%
C+ = 67-69%	C = 63-66%	C- = 60-62%
D+ = 57-59%	D = 53-56%	D- = 50-52%
F = <50%		

WDN = Withdrawn from the course

DEF = Deferred

Academic Accommodations, Regulations, Plagiarism, Etc.

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University. More information can be found on the Course Outline Information webpage.

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the Academic Regulations website.

Academic Accommodations for Students with Disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your

instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. For more details, visit the Paul Menton Centre website.

Addressing Human Rights Concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca.

Religious Obligations

Please contact me 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, please review the Student Guide to Academic Accommodation (PDF, 2.1 MB).

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 the Sexual Violence Prevention and Survivor Support website.

Accommodations for Missed Work

Carleton recognizes that students may experience unexpected, temporary incapacitation (for example: illness, injury, or extraordinary circumstances outside of a student's control). As a result, Carleton has put into place a protocol for students to apply for accommodations using a self-declaration form in the event of missed work.

The form can be filled out on the Academic Consideration for Coursework Form webpage. Note that these forms should be used for short-term concerns related to missed work; if you are experiencing chronic, ongoing challenges which necessitate a broader solution, I recommend reaching out to the Paul Menton Centre and/or the Care Support team.

- Deferred/missed term work for short-term accommodation (5 days or less): write to me via email and we will discuss if accommodations are needed. No accommodations are anticipated for assignments because the lowest 2 assignment grades are dropped.

- Deferred/missed term work for longer term incapacitation (5 days or longer); If you require accommodations for this course that are longer than the 5-day (short-term) period, please email me to discuss how/whether accommodation needs could be met for this course.

Pregnancy

Please contact me 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, please review the Student Guide to Academic Accommodation (PDF, 2.1 MB).

Accommodation 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 me 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 Senate Policy on Accommodation for Student Activities (PDF, 25KB).

Academic Integrity

Academic misconduct undermines the values of honesty, trust, respect, fairness, and responsibility that we expect in this class. Carleton University provides supports such as academic integrity workshops to ensure, as far as possible, that all students understand the norms and standards of academic integrity that we expect you to uphold. Your teaching team has a responsibility to ensure that their application of the Academic Integrity Policy upholds the university's collective commitments to fairness, equity, and integrity. (Adapted from Carleton University's Academic Integrity Policy, 2021).

Examples of actions that do not adhere to Carleton's Academic Integrity Policy include:

- Plagiarism
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams

Sanctions for not abiding by Carleton's Academic Integrity Policy

A student who has not upheld their responsibilities under Carleton's Academic Integrity Policy may be subject to one of several sanctions. Details about this process can be found on the Faculty of Science Academic Integrity website. Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy. The Policy is strictly enforced and is binding on all students.

Student Rights and 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): Daniel Stolarski (Graduate Chair, Physics); Kevin Graham (Department Chair); and Office of the Dean of Science.

Note: You can also bring your concerns to Ombuds services.

Assistance for Students

- Paul Menton Centre
- Academic Advising Centre (AAC)
- Centre for Student Academic Support (CSAS)
- Academic Advising Centre (AAC)
- Math Tutorial Centre
- Science Student Success Centre
- Mental Health and Wellbeing
- Health and Counselling Services
- Equity and Inclusivity Communities