PHYS 5206 Medical Radiotherapy Physics

Course Instructor: Emily Heath

How to address me: Dr/Prof Heath

Gender Pronouns: she/her/hers

Email: Emily.Heath@Carleton.ca

Phone: (613) 555-2829 ext. 4053

Student Hours: Mondays & Fridays, 11am – 12pm

Office Location: Room 2424, Herzberg Laboratories

Class Location: posted on Brightspace

Class Times: Monday & Wednesday, 4:05pm-5:25pm

Prerequisites: PHYS 5203

Website: https://carleton.brightspace.com/

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 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.

Algonquin 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, reflect on how you can support anti-racism and decolonization, and take action. https://carleton.ca/indigenous/

Welcome to this Course!

The goal of this course is to provide an overview of modern radiotherapy, its purposes, its techniques, and the importance of physics in its practice. The first part of this course builds upon the concepts taught in PHYS 5203 and applies them to the measurement of radiation dose distributions. The second part of the course focusses on clinical treatment planning with emphasis on calculation of clinical radiation dose distributions in both external beam radiation therapy and brachytherapy.

Calendar entry: Radiation therapy process and physics. Ion chamber dosimetry, Monte Carlo techniques of radiation transport, cavity theories, external beam therapy, brachytherapy, dosimetry protocols, detectors used in radiation therapy. Treatment planning, monitor unit calculations, intensity-modulated radiation therapy. Novel and alternate techniques**.**

Course level learning objectives:

After completion of this course, students will be able to:

1. develop a deep understanding of the fundamentals or radiation dosimetry, with special emphasis on ion chamber dosimetry under reference conditions (TG-51, TG-61) and under non-standard conditions in small and/or composite fields;
2. become familiar with the general characteristics of many types of radiation detectors and their relative strengths and weaknesses;
3. understand the physics behind the structure of dose distributions for photon beams, electron beams and brachytherapy sources;
4. understand the physics behind TARs, TPRs, TMRs, PDDs and the relationships between them;
5. perform a simple hand calc monitor unit calculation;
6. understand the basic physics behind dose calculation algorithms for treatment planning and to understand the limitations of each;
7. become familiar with the elements of Monte Carlo simulation as applied in radiotherapy applications
8. understand the TG-43 formalism for brachytherapy dosimetry and its limitations.

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/

Community Guidelines

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

	As students, we will…	As a teaching team, we will…
Honesty	• Honestly demonstrate our knowledge and abilities on assignments and exams • Communicate openly without using deception, including citing appropriate sources	• 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	• 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	• Give you timely feedback on your assignments and exams • Show up to class on time, and be mentally & physically present • Create relevant assessments and class activities
Respect	• Speak openly with one another, while respecting diverse viewpoints and perspectives • Provide sufficient space for others to voice their ideas	• Respect your perspectives even while we challenge you to think more deeply and critically • Help facilitate respectful exchange of ideas
Fairness	• Contribute fully and equally to collaborative work, so that we are not freeloading off of others • Not seek unfair advantage over fellow students in the course	• Create fair assignments and exams, and grade them in a fair, and timely manner • Treat all students equitably
Trust	• 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	• 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	• 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	• Say or do something when we see actions that undermine any of the above values • Accept the consequences (e.g., lower teaching evaluations) of upholding and protecting the above values

* This class statement of values is adapted from Tricia Bertram Gallant, Ph.D.

Learning Materials

Texts: All four of these textbooks are available as ebooks at Carleton's MacOdrum Library [no need to buy!]

- P. Andreo, D.T. Burns, A.E. Nahum, J. Seuntjens, & F.H. Attix, Fundamentals of Ionizing Radiation Dosimetry, 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, 2021.
- Battista, J. (ed.), Introduction to Megavoltage X-Ray Dose Computation Algorithms (1st ed.), 2019.
- Rogers, D.W.O., Radiotherapy Radiation Physics: A Monte Carlo Approach*

*this is a draft of a book being written by Dr. Rogers. I will post a pdf version of the most current book draft on Brightspace. As this book is not yet published the pdf should be for your own use and not shared with anyone outside of this course.

Technology Checklist:

☐ An internet-enabled computer (laptop/desktop) with appropriate software for assignments

☐ Access to reliable internet for using course website

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 using methods such as grading assignments one question at a time (i.e., grading all of question 1 before grading any of question 2), grading anonymously, and using rubrics.

Grade Breakdown

COMPONENT	GRADE VALUE
ASSIGNMENTS	40%
MIDTERM TESTS	20%
FINAL EXAM	20%
ORAL INTERVIEW	10%
PROJECT/PRESENTATION	10%

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 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 Tests

There will be two 70-minute tests held in class, tentative dates February 14th and March 18th. These dates may possibly be adjusted to avoid conflict with PHYS 5208 tests.

Looking for help preparing for midterms? Student Academic Success Services (SASS) 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 15 minute oral interview with each student will take place during the final exam period.

Project/Presentation

The last two lectures of the semester (April 4th and 8th) will be devoted to student presentations on projects which will be assigned by the end of January. Each student will have about 20 minutes to speak and will be required to prepare a 1 to 3 page handout on their topic. A list of possible topics will be provided earlier in January and you will be asked to choose your topic, possibly after negotiating with another student (to avoid duplication).

By February 28 each of you must prepare a 3 sentence/point summary of the papers you intend to review (suggestions can be made but the final choice (subject to review in early March) will be yours). Then 3 weeks prior to the talks (by March 13) you must submit a draft of your handout for feedback. You will only be marked on your presentation and the final draft of your handout, so even if I have major comments on your draft handout, you have a chance to recover (like a referee's comments on a research paper) - but it pays to get the draft to me in good time so you have time to rework it before your presentation.

Hospital tour

Depending on COVID restrictions, there may be an opportunity to tour facilities at the Ottawa General Hospital Cancer Centre which are related to the material being taught in the course. Participation in this tour is entirely optional.

Feeling Sick?

If you feel very sick (e.g., fever, chills, stomach upset) do not come to class or campus. Contact the instructor if you will be unable to meet an assignment deadline due to illness.

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. I'll work with you, I promise. Remember that Carleton also offers an array of mental health and well-being resources, which can be found here.

Online Community Expectations for Social Platforms

With the growing use of social platforms (e.g., Discord) on campuses, it is important to keep in mind that university codes of conduct still apply to the behaviours of students online. Please be considerate and respectful while engaging with peers and remember that we are all humans, and that your words matter. If any student witnesses or experiences harassment, I encourage you to reach out to me. Alternatively, you can contact Ombuds Services or Carleton Equity and Inclusive Communities.

Online communities can be highly beneficial to students and can help to facilitate learning within the course. I encourage people to ask questions, learn from one another, and have open discussions about class material. That said, any acts of academic misconduct (i.e., cheating) will not be tolerated and will result in serious consequences ranging from a grade reduction to expulsion (*see academic integrity violations*).

- Examples of appropriate peer-to-peer sharing/learning vary from course to course. In this course appropriate peer-to-peer sharing includes: identifying the proper formula to use, identifying an incorrect or missing step in a person's work, brainstorming potential reasons behind a concept, suggesting helpful sites and videos for learning a concept, posting your own work showing only a specific step or process for illustrative purposes (note: this is very different from posting your work and solution for others to simply copy)
- Examples of unacceptable peer-to-peer sharing: Posting or sharing the answers, indicating which answers are correct on assignments, sharing links to solutions, posting your own complete work for a question/solution

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	B+ = 77-79	C+ = 67-69	D+ = 57-59
A = 85-89	B = 73-76	C = 63-66	D = 53-56
A- = 80-84	B- = 70-72	C- = 60-62	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 at: https://students.carleton.ca/course-outline/

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:

https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/

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 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: https://carleton.ca/sexual-violence-support/

Accommodations for Missed Work

Carleton recognizes that students may experience unexpected, temporary incapacitation (i.e., 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 found at: https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf 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.

For 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 Integrity is upholding the values of honesty, trust, respect, fairness, responsibility, and courage that are fundamental to the educational experience. 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
- Using artificial intelligence tools such as ChatGPT when your assessment instructions say that it is not permitted

Please review the checklist linked here to ensure you understand your responsibilities as a student with respect to academic integrity and this course.

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. A list of standard sanctions in 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 follow the Carleton University Student Academic Integrity Policy. The Policy is strictly enforced and is binding on all students.

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.

Assistance for Students

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/

Week	Monday	Tuesday	Wednesday	Thursday	Friday
January					
1	*Winter term begins* *Lecture 1* 8	9	*Lecture 2* 10	11	12
2	*Lecture 3* 15	16	*Lecture 4* 17	18	19
3	*Lecture 5* 22	23	*Lecture 6* 24	25	26
4	*Lecture 7* 29	30	*Lecture 8* 31	1	2
February					
5	*Lecture 9* 5	6	*Lecture 10* 4	5	6
6	*Lecture 11* 12	13	*Midterm test #1* 14	15	16
No Classes	*Fall Break* 19	*Fall Break* 20	*Fall Break* 21	*Fall Break* 22	*Fall Break* 23
7	*Lecture 12* 26	27	*Lecture 13* 28 *3 sentence summary due*	29	1
March					
8	*Lecture 14* 4	5	*Lecture 15* 6	7	8
9	*Lecture 16* 11	12	*Lecture 17* 13 *Presentation handout due*	14	15
10	*Lecture 18* 18	19	*Midterm test #2* 20	21	22
11	*Lecture 19* 25	26	*Lecture 20* 27	28	*Statutory holiday* *University closed* 29
April					
12	*Lecture 21* 1	2	*Presentations* 3	4	5
13	*Presentations* 8	9	*Winter term ends* 10	11	12