

Radiological Physics

Physics 4672/9655A

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Office hours: by appointment

Time Tuesday 2:30-4:30 pm, Thursday 2:30-3:30 pm
Place PAB 26, Western University

Textbook: *Radiation Physics for Medical Physicists*, E.B. Podgorsak, 3rd edition*, Springer-Verlag (2016). Note that the 3rd edition contained additional chapters on radiation dose measurements that are not present in the 1st or 2nd editions and will be covered in this course.

References:

1. *Compendium to Radiation Physics for Medical Physicists: 300 Problems and Solutions*, E.B. Podgorsak, Springer-Verlag (2014).
2. *Fundamentals of Ionizing Radiation Dosimetry*, Pedro Andreo, David T. Burns, Alan E. Nahum, Jan Seuntjens, Frank Herbert Attix, Wiley (July 31, 2017)

Learning Outcomes: At the end of the course, students will be able to

1. identify and explain the mechanisms of radiation generation from man-made and natural **sources**.
2. use appropriate defined quantities and terminologies to **describe** radiation.
3. obtain and apply **radioactive decay** data from the National Nuclear Data Center (NNDC).
4. utilize tabulated properties from the National Institute of Standards and Technology (NIST) to determine when and what **interactions** are important in different materials for **charged** and **uncharged** particles.
5. analyze the effects of different materials on radiation **transport**.
6. explain how charged and uncharged radiation **deposits energy** and quantify such radiation dose deposition.
7. explain the fundamentals on how ionization radiation dose can be **measured**, and strengths and limitations of different dosimeters
8. explain the principles behind radiation safety and perform **quantitative risk analyses** on the safe use of radiation

	Podgorsak 3 rd ed. Chap.	Attix 2 nd ed. Chap.
September		
Introduction to Ionizing Radiation:		
• quantities, units, counting statistics, Radiation sources (radioactivity, x-ray tubes, accelerators, reactors, cyclotrons)	1	1
Radioactivity	10, 11	18
• Modes and kinetics of radioactive decays		
Interactions of x and γ rays with matter I – overview:	7	5, 3
• interpretation of the exponential attenuation of photons		
October		
Interactions of x and γ rays with matter II:		
• Thomson and Compton scattering	7	3
Interactions of x and γ rays with matter III:	7	3
• Coherent scattering, Photoelectric effect, Pair production		

	Interactions of charged particles with matter I:	6	2
	• Scattering and stopping powers		
	Interactions of charged particles with matter II:	6	2, 7
	• X-ray production (Bremsstrahlung)		
	Mid-term exam		
November	Inter-relationship of Quantities:		
	Fluence, mass energy transfer/absorption coefficient, collisional/radiative KERMA, absorbed dose, charged particle equilibrium	8, 15	4
	Convolution dose calculation, charged particle disequilibrium	handout	handout
	Monte Carlo Method	handout	8, handout
	Fundamentals of Dosimetry	15	10
	Absolute dosimeters	16	
	• Ionization chambers, calorimetry, chemical dosimeter		
	• Cavity theory and dose measurement with ion chambers	15	9, handout
December	Relative dosimeters		
	• diodes, film, TLD, OSL, etc.	17	12,14
	Radiation Protection Guidelines & Canadian Regulations	handout	handout
	Review		

Evaluations:

- 5 homework assignments (30%):
These assignments are there to help you learn the subject matter. A portion could be extension of what was taught in class and might contain materials that help you learn on your own. You may talk to each other about the assignments, but it would only help if you compose your thoughts and write your own assignments, rather than simply copying. Please see statement below on plagiarism.
- Mid-term exam (25%)
- Final exam (45%): Scheduled by the office of the registrar.
- The Department of Physics and Astronomy may, in exceptional cases, adjust the final course marks in order to conform to Departmental policy.

Co-requisites:

- Phys 3300A/B
- Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Academic Policies:

The website for Registrarial Services is <http://www.registrar.uwo.ca>.

In accordance with policy, <http://www.uwo.ca/its/identity/activatenonstudent.html>, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

Scholastic Offenses:

Cheating

University policy states that cheating is a scholastic offence. Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: [http://](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)

www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

The commission of a scholastic offence is attended by academic penalty, which may include expulsion from the program. If you are caught cheating, there will be no second warning. Cheating includes having available any other electronic devices than a watch and a calculator during a test or exam. You may not have a cell phone accessible, even to use it as a calculator or watch.

Plagiarism

Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

Accommodation:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation to the Academic Counselling Office of your home faculty as soon as possible. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in WSC 140, and can be contacted at scibmsac@uwo.ca.

For further information, please consult the university's medical illness policy at http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Students who are in emotional/mental distress should refer to Mental Health@Western <http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help.

Support Services:

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

The policy on Accommodation for Students with Disabilities can be found here: www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

The policy on Accommodation for Religious Holidays can be found here: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf