McGILL UNIVERSITY

Radiation Physics: MDPH 601

FALL SEMESTER 2023

Schedule Version Dated: Aug 21, 2023

PLEASE EXPECT UPDATES and ADJUSTMENTS

Lecturers: Peter Watson, Ph.D., MCCPM
Cedars Cancer Centre, DS1-9327
McGill University Health Centre – Glen Campus
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Piotr Pater, Ph.D., FCCPM
Cedars Cancer Centre, DS1-5116
McGill University Health Centre – Glen Campus
Email: piotr.pater@mcgill.ca

Time: **11h00 - 12h30 Eastern time Mondays**

11h00 – 12h30 Eastern time Wednesdays

Place: DS1.5034 (Glen Campus, Cedars Cancer Centre)

Textbooks: P. Andreo, D.T. Burns, A.E. Nahum, J. Seuntjens, F.H. Attix, ***Fundamentals of Ionizing Radiation Dosimetry*** (Wiley)

E.B. Podgorsak, ***Radiation Physics for Medical Physicists***, Springer, 2nd edition or 3rd edition

Office hours: Reachable by email and meeting can be arranged

Exams: **Midterm** (written): October 30
Final December 19 (written), 20-21 (oral)

Plan to be available in-person for ORAL examination until Dec 21, 2023

Note: To qualify for the final oral exam, the student must achieve at least 70 points for written work based on homework assignments (max. 20 points), midterm exam (max. 30 points), and final written exam (max. 50 points).

Final grade:	***20% Assignments, 30% Midterm, 25% Written Final, 25% Oral Final***

Date	Topic	Contents	Instructor
Aug 30	What is medical physics and role of radiation physics?	Overview of medical physics, education, certification, profession	P. Pater
Sept 6	Background and Essentials	Overview of modern physics and some uncertainty concepts	P. Watson
Sept 11	Exponential attenuation	Attenuation and energy absorption	P. Pater
Sept 13	Photon interactions (I)	Thomson, Rayleigh scattering, Photoelectric effect	P. Pater
Sept 18	Assignment 1 due		
Sept 18	Photon interactions (II)	Compton, kinematics properties	P. Pater
Sept 20	Photon interactions (III)	Klein Nishina cross section properties, binding and impulse approximation, energy transfer	P. Pater
Sept 25	Photon interactions (IV)	Pair and triplet, photo nuclear reactions	P. Pater
Sept 27	Attenuation and energy absorption – revisited	Tying together the photon interactions with the concept of energy transfer	P. Pater
Oct 2	Assignment 2 due		
Oct 2	Charged particle physics (I)	Rutherford scattering	P. Watson
Oct 4	Charged particle physics (II)	Screening effects and finite size effects	P. Watson
Oct 16	Charged particle physics (III)	Multiple scattering, scattering power, properties	P. Watson
Oct 18	Assignment 3 due		
Oct 18	Atom structure and models (I)	Bohr model, COM correction	P. Watson
Oct 23	Atom structure and models (II)	Multielectron atoms and experimental validation of atom models	P. Watson
Oct 25	Radiation production (I)	Atomic relaxation. Fluorescence yield. Auger effect.	P. Watson
Oct 30	**Midterm**		
Nov 1	Radiation production (II)	Accelerated charges, bremsstrahlung, synchrotron radiation	P. Watson
Nov 6	Assignment 4 due		
Nov 6	Stopping power for heavy charged particles	Derivation of electronic stopping power for heavy charged particles, soft and hard collisions, shell corrections, density effect corrections.	P. Watson
Nov 8	Stopping power for electrons and positrons, restricted stopping power	Properties of stopping power for electrons and positrons	P. Watson

Nov 13	Radiation dosimetry concepts (I)	Energy transferred, net energy transferred, kerma, electronic kerma, relation to energy-transfer coefficients, exposure, CPE	P. Pater
Nov 15	Radiation dosimetry concepts (II)	Free-air chamber, CPE, energy imparted, CEMA, absorbed dose	P. Pater
Nov 20	Assignment 5 due		
Nov 20	Monte Carlo Simulation	General principles of MC, sampling, photon transport, electron transport	P. Watson
Nov 22	Radiation Standards for absorbed dose	Radiation chemistry in water. Fricke dosimetry. Water calorimeters. Graphite calorimeters.	P. Watson
Nov 27	Cavity theory (I)	Equilibrium fluence, Fano theorem, Bragg Gray cavity theory.	P. Pater
Nov 29	Cavity theory (II)	Spencer Attix cavity theory, large cavities, small cavities, Burlin cavity theory.	P. Pater
Nov 30* (Thur)	Radiation detector theory focused on ionization chambers	Ionization chamber functioning. N_gas concept. Deriving K_air from signal to cavity chamber. Cavity ionization chamber-based air kerma standard. Calibration chain.	P. Pater
Dec 4	Assignment 6 due		
Dec 4	*Review of course material*		P. Watson P. Pater
Dec 19	Final written		
Dec 20-21	Oral exams	*Schedule of individual timeslots will be circulated*	

Please note:

- This is the planned schedule and is subject to change with clear notice. If there is a modification an updated schedule will be posted and clearly communicated.
- Light blue are provisional assignment deadline dates. Upload assignment documents to MyCourses by the stated deadline.
- Pink dates are midterm and final exam dates.
- The material for the final exam comprises material taught during the entire semester.
- We follow the Academic Integrity Policy (Plagiarism and Cheating) posted at: https://www.mcgill.ca/students/srr/academicrights/integrity
- Students are responsible for knowing their responsibilities with respect to any and all course and calendar deadlines, and registration, withdrawal, and failure policies. Requests for action outside of McGill policies and deadlines will generally not be supported by the MPU.
- McGill Key Dates: https://www.mcgill.ca/importantdates/key-dates
- McGill information on Courses and Programs (including how to change your Courses): https://www.mcgill.ca/students/courses/
- McGill Failure Policy: https://www.mcgill.ca/study/2021-2022/university_regulations_and_resources/graduate/gps_gi_failure_policy