Health Physics

MDPH 613 (2 credits)

Fall 2017

Course Description

This is a graduate-level course that provides students in the McGill Medical Physics program with an introduction to radiation protection. The course examines the role of radiation in public health. It involves a study of the physics and biology of radiation interactions with matter and tissue and examines the application of our scientific knowledge to the formulation of public health policy. The course covers a broad range of subjects from pure science to law and ethics and draws upon publications by national and international bodies.

The application of radiation protection to the medical environment is studied in detail and students participate in a laboratory exercise to design and optimize radiation shielding for a radiotherapy clinic in order to comply with national regulations and following international design recommendations.

Course Instructor

John Kildea (depdocs.com/jkildea)

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Several guest lectures in the second half of the semester will be presented by William Parker

Timetable

Unless otherwise arranged, classes for this course will be held on Friday mornings from 10 am to 12 pm in the Department of Radiation Oncology at the Cedars Cancer Centre

Several laboratory sessions and/or a field trip outside of scheduled classes are anticipated.

A schedule of class topics is provided below.

Class Materials and Handouts

Slides, notes, announcements, and the results of quizzes and exams will be available via the McGill myCourses website.

A comprehensive set of notes is provided. However, please be aware that the exams and assessments may require that you apply what you have learned beyond the material in the notes.

Text Books

No specific textbook is recommended for this course. Class materials and the notes provided should be sufficient.

However, the following books were used in the preparation of class material:

- Introduction to Health Physics by Cember
- Practical Radiation Protection in Health Care by Martin
- Radiation Physics for Medical Physicists by Podgorsak
- Physics in Nuclear Medicine by Cherry, Sorenson and Phelps

Recommended Readings

Students may find the following (free via the McGill library website) publications useful during the course:

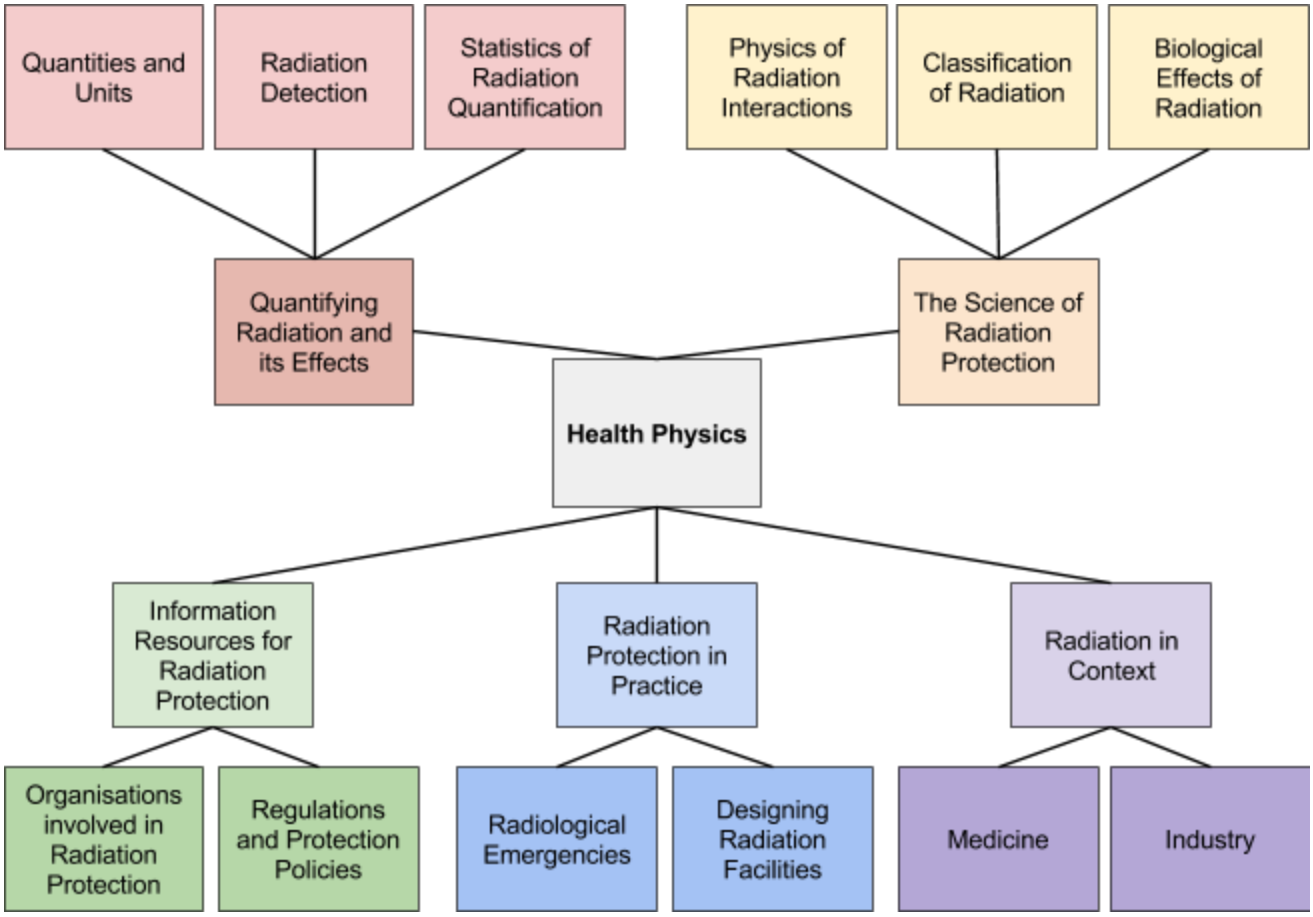
- Radiation Protection in the Design of Radiotherapy Facilities - IAEA Publications Catalogue - Safety Reports Series No. 47
- The 2007 Recommendations of the International Commission on Radiological Protection - ICRP Publication 103
- The Canadian Nuclear Safety Commission - Laws and Regulations

Bedtime Reading

The following two popular science books are suggested as interesting reads that provide some context to the class and to oncology:

- The Emperor of All Maladies by Siddhartha Mukherjee
- Strange Glow: The Story of Radiation by Timothy J. Jorgensen

Conceptual Overview of the Course



Shielding Laboratory

A shielding lab will be held during one weekend of the semester, after the shielding material has been covered in the lectures. Students will be advised of the date and time in advance.

Tour of Nuclear Medicine, Diagnostic Radiology and Interventional Medicine

A tour of the Nuclear Medicine, Diagnostic Radiology and Interventional Medicine facilities of the MUHC may be arranged during the semester if possible. The tour will likely take place outside of regular class hours. Students will be advised in advance.

Student Evaluation

Pass mark is 65%

Assessment Method	Weight (%)
Class quizzes 10 quizzes worth 2% each	20
Radiation safety scenarios Continuous assessment	10
Midterm exam Closed book	30
Final exam Closed book, including material from before midterm exam	40

Assessments

The main purpose of the assessments is to ensure that students achieve competency in introductory Health Physics.

Since the class is held just once a week there is often a tendency to neglect the material between classes with the result being a panic before the midterm and final exams. With 30% of the overall mark dependent on continuous assessment (quizzes and radiation safety scenarios), each student has an opportunity to improve her/his exam grade by studying during the semester. This should also relieve the study stress at the time of the midterms and finals.

Quizzes

A multiple-choice quiz will be held at the beginning of each class.

The quiz will last at most 15 minutes (including the time spent handling the paperwork) and will incorporate any or all of the material covered in the course until that point.

Students are encouraged to discuss amongst themselves the quiz topics and the course material in advance of each class.

Radiation Safety Scenarios

Each student will be randomly assigned a radiation safety scenario during the first lecture.

During the week between lectures, students should review the material of the most recent lecture and place it in the context of the radiation safety scenario they were assigned.

Each student should prepare a brief summary of how the material they have reviewed relates to their assigned scenario.

Students are encouraged to use the provided Google form to prepare their summaries online for continuous instructor review. The details will be discussed during the first lecture.

Office Hours

Due to my clinical responsibilities, I cannot list regular office hours in advance. However, if you need to talk to me about any aspect of the course please email me and we can arrange a meeting time. You may also approach me at my office or in the clinic at any time.

Miscellaneous

Questions and student interaction during the classes are encouraged!

If you are getting low marks in the quizzes please seek help. It has been noticed that quiz grades and final grades are tightly correlated.

Please seek help immediately if you feel you are falling behind in this or any other class. Don't wait until it is too late! We are here to help.

Course Outline (final schedule will likely change depending on pace of class)

Date	Material
Friday, 8 September 2017 JK - 1	**Introduction to Health Physics** Public and private health Health physics and medical physics The role of a health physicist **A review of radiation physics** Definition of radiation The inverse-square law The Bohr-Rutherford atomic model Ionization and ionizing radiation Background radiation The basic physics of radiation protection Distance, time, shielding and scatter
Friday, 15 September 2017 JK - 2	**Quantification of radiation** Physical, dosimetric, biological and legal/regulatory quantities
Friday, 22 September 2017 JK - 3	**Detection of radiation** A review of radiation detectors Gas-filled detectors TLDs and OSLDs Scintillation detectors Semiconductor detectors Photographic emulsion detectors Neutron detectors Detector calibration and usage
Friday, 29 September 2017 JK - 4	**Biological effects of radiation** Sources of information

	The human organism Radiation damage - at the cellular level Radiation damage - macroscopic effects Stochastic effects and ALARA Effects of in-utero irradiation
Friday, 6 October 2017 JK - 5	**Radiation protection organisations** Historical perspective Jurisdiction Modern organizations involved in radiation protection
Friday, 13 October 2017 (probably will be rescheduled) JK - 6	**Radiation protection regulations** Canadian laws and regulations pertaining to radiation protection Quebec regulations pertaining to radiation protection Transport of radioactive material
Friday, 20 October 2017 JK - 7	**Radiation Protection in Practice** Context Categories of exposed individuals Principles of Radiation Protection Radiation Protection Program
Friday, 27 October 2017 JK - 8	**Medical Radiation** Radiotherapy Diagnostic Radiology Nuclear Medicine Interventional Medicine Laboratories Tour of the MUHC Diagnostic Radiology facilities
May be rescheduled earlier or later in	**Midterm exam**

the list of classes JK - 9	Format will be similar to quizzes
Friday, 3 November 2017 JK - 10	**The nuclear power industry** Historical perspective Nuclear power production and reactor types Nuclear power plants in Canada and around the world Nuclear power safety and radiation exposure in the context of nuclear power Nuclear power accidents **Neutrons and basic shielding concepts** Production, interactions and protection
Friday, 10 November 2017 WP - 1	**Shielding design for hospital radiation facilities - diagnostic**
Friday, 17 November 2017 WP - 2	**Shielding design for hospital radiation facilities - therapy**
Weekend class (May be rescheduled earlier or later in the list of classes) ME - 1	**Radiation therapy shielding laboratory** Hands-on shielding calculations and measurements at the MUHC
Friday, 24 November 2017 (probably will be rescheduled) JK - 11	**Statistical analysis in radiation quantification** Errors and uncertainties, type A and B Probability distributions and dispersion indices Binomial, Poisson and Gaussian distributions Central Limit Theorem Confidence limits, propagation of errors and minimum detectable activity
Friday, 1 December 2017 JK - 12	**Radiation protection scenarios and review**
TBD	**Final exam**

JK - 13	