**McGILL UNIVERSITY**

**MDPH 615 - PHYSICS OF NUCLEAR MEDICINE**

**Fall 2024**

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**Instructors**: **Shirin Abbasinejad Enger, Ph.D. (yellow boxes on course outline)**
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**Student hours:** Virtually, by appointment.

**Time**: Tuesday 9:00 – 11:00

**Place**: Class will be held 100% in person.
Room DS1.1427 (September), DS1.5034 (October and after)
Cedars Cancer Centre, MUHC Glen Site
1001 Decarie, Montreal

**Textbooks**: S. Cherry, J. Sorenson, M. Phelps:
***Physics in Nuclear Medicine***
Elsevier (4th Edition, 2012)

E. B. Podgorsak:
***Radiation Physics for Medical Physicists***
Springer (2006)

Glen F. Knoll
**Radiation detection and measurement**

**Plus, lecture notes from the instructors**

**Exam 1 (mid-term): Tuesday, October 29, 9 am (in class).**
**Exam 2 (end-of-term): Wednesday, December 11, 9 am to noon. (Non-cumulative)**

**Class outline:**
Medical Physics: The physics of radioactivity and the applications of radioisotopes and radiopharmaceuticals in medical diagnosis. Topics covered include radiation spectrometry, the scintillation camera, image analysis and data processing in nuclear medicine, single photon emission tomography, and positron emission tomography.

**Delivery and course materials:**
The class will be delivered using a mix of lectures and question-and-answer sessions held in person. There will also be readings, and pre-recorded videos. Course materials will be posted on MyCourses.

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**Learning Outcomes:** By the end of this course, the student should be able to:

1. Be familiar with radionuclides used in nuclear imaging and therapy, production of these radionuclides and their dosimetry and be able to describe the radioactive decay.
2. Describe the mechanism of action of organic and inorganic scintillators and the analog components of a scintillating counting system.
3. Describe and understand the principles of the major imaging modalities in nuclear medicine, along with their advantages and limitations.
4. Understand how image reconstruction approaches are applied to nuclear medicine imaging data.

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**Assessment:** There will be assignments (consisting of problem sets, writing, programming, and/or readings), regular graded quizzes, a mid-term exam, and a final exam.

**Quizzes (10%)** (average of all quiz grades)
**Assignments (20%)** (5% per assignment x 4 assignments)
**Exam 1 (40%)**
**Exam 2 (non-cumulative, 30%)**

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**McGill Policies:**

**1)** *McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/) for more information).*

**2)** *In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.*

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**Health and Wellness Resources at McGill:**

Student well-being is a priority for the University. All of our health and wellness resources have been integrated into a single Student Wellness Hub, your one-stop shop for everything related to your physical and mental health. If you need to access services or get more information, visit the Virtual Hub at mcgill.ca/wellness-hub or drop by the Brown Student Services Building (downtown) or Centennial Centre (Macdonald Campus). Within your faculty, you can also contact your Local Wellness Advisor (to make an appointment, visit mcgill.ca/lwa).

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## Course Outline

| Session | Date | Lecture Title | Reading |
|---|---|---|---|
| 1 | 2024/09/03 | Introduction to Nuclear Medicine &<br>Modes of Radioactivity | Cherry, chap. 1, 2, 3<br>Dr. Enger's notes |
| 2 | 2024/09/10 | Decay of Radioactivity – Bateman Equation | Cherry, chap. 4<br>Dr. Enger's notes |
| 3 | 2024/09/17 | Radionuclide production | Cherry, chap. 5<br>Dr. Enger's notes |
| 4 | 2024/09/24 | Nuclear Radiation Measurements – Scintillation Counting Systems | Knoll, chap. 8<br>Cherry, chap. 7 & 8 |
| 5 | 2024/10/01 | Nuclear Radiation Measurements – Pulse-Height Spectrometry | Knoll, chap. 8<br>Cherry, chap. 7 & 8 |
| 6 | 2024/10/08 | Internal radiation Dosimetry | Dr. Enger's notes |
| – | 2024/10/15 | Fall Break | — |
| 7 | 2024/10/22 | Radiopharmaceuticals for Radiotherapy | Dr. Enger's notes |
| 8 | 2024/10/29 | **Exam 1** | |
| 9 | 2024/11/05 | Gamma camera – Basic Properties and Performance Characteristics | Cherry, chap. 13, 14, and 15 |
| 10 | 2024/11/12 | Single Positron Emission Tomography (SPECT) | Cherry, chap. 17 & 19 |
| 11 | 2024/11/19 | Positron Emission Tomography (PET) | Cherry, chap. 18, 19 |
| 12 | 2024/11/26 | Image reconstruction in Nuclear Medicine | Cherry, chap. 16 |
| 13 | 2024/12/03 | Radiopharmaceuticals for NM Imaging;<br>Quantitative analysis of NM images | Cherry, chap. 5, 17, 18, 20, and 21 (sections only) |
| | **2024/12/11** | **Exam 2 (**Wednesday AM, 9 am – noon) | |

*NOTE: Under appropriate circumstances, the contents of this document can be modified by the instructors to allow for adjustments in the course.*

2024-08-28