CHEMISTRY 628
Nuclear and Radiochemistry

Spring Semester 2018
SYLLABUS

Objective:

The objective of this course is to explore the fundamental aspects of nuclear and radiochemistry, with emphasis on the determination of radioactive species and the application of nuclear processes, radioactive materials, and radiochemical techniques in chemical analysis.

Instructor:

Dr. Mark Dietz	*Office:*	Chemistry 643
	Office Hours:	Tuesday / Thursday 2:00 to 3:00 pm (or by appointment)
	Contact info:	telephone: (414) 229-1748 (office) (414) 229-1749 (lab) email: dietzm@uwm.edu

If you cannot attend my office hours, talk to me after lecture so that we can arrange a time to meet to discuss your questions. (You may also telephone or e-mail me to set a time to meet.)

Class Schedule:

Lecture: T/R 12:30-1:45 CHM 197

Learning Outcomes:

It is expected that upon completion of this course, students will understand the origins of nuclear instability, the fundamental aspects of radioactive decay, the modes of interaction of radiation with matter, the relationship between the nature of these interactions and radiation detection / measurement, and the analytical applications of nuclear reactions and nuclear materials.

Course Materials:

Suggested text:

There is, unfortunately, no single textbook that is adequate for purposes of this course. One book that you may find useful, yet not so useful that its purchase is required, is the following:

G. Choppin, J.-O. Liljenzin, J. Rydberg, *Radiochemistry and Nuclear Chemistry*, *3rd edition*, Butterworth-Heinemann, Woburn, MA, 2002 (ISBN-13: 978-0-7506-7463-8; ISBN-10: 0-7506-7463-6; QD601.3.C48 2001)

Other resources:

G. Choppin, P. Baisden, *Radiochemistry*, Notes to accompany the American Chemical Society Audio Course by the same name, 1978. (Available as pdf file.)

Useful supplemental references:

J. C. Bryan, *Introduction to Nuclear Science*, 2nd edition, CRC Press, Boca Raton, FL, 2013.

G. F. Knoll, *Radiation Detection and Measurement*, 3rd edition, Wiley, New York, 2000.

M. F. L'Annunziata (Ed.), *Handbook of Radioactivity Analysis*, Academic Press, New York, 1998.

N. Tsoulfanidis, *Measurement and Detection of Radiation*, 2nd edition, Taylor and Francis, Washington, DC, 1995.

W. D. Ehmann, D. E. Vance, *Radiochemistry and Nuclear Methods of Analysis,* Wiley Interscience, New York, 1991.

G. D. Chase, J. L. Rabinowitz, *Principles of Radioisotope Methodology*, 3rd edition, Burgess Publishing, Minneapolis, MN, 1967.

Policies:

Attendance. Attendance is taken only at the beginning of the semester. It is nonetheless important that you attend each lecture. Regardless of attendance, you will be held responsible for the information presented in the lecture sessions. If you miss a lecture, you are responsible for obtaining the lecture material.

Recording devices. As described in *Academic & Administrative Policies, Paragraph S52*, I elect not to permit my lectures to be tape-recorded (or preserved by any equivalent digital means).

Make-up work. Opportunities for "make-up" exams are not normally provided. For a scheduled absence (*e.g*., attendance at a professional meeting), please notify me *at least 48 hours prior to the absence*. For medical absences, a written letter from a physician to me is required. If an exam is missed for reasons *not approved beforehand* by me, a grade of **zero** will be given. For an *excused absence* from an exam, the grade on the next exam will count *double*.

Special accommodations. Students requiring accommodations to meet any of the requirements of this course should contact me as soon as possible, preferably within the first few class meetings.

Influenza guidance. In the event of a disruption of normal classroom activities due to a flu outbreak or other unanticipated occurrence, the format of this course may be modified to enable its completion. In such an event, you will be provided with a modified version of this syllabus that will supersede this document.

Academic dishonesty. Cheating on an examination or other graded assignment will result in a grade of zero on that examination/assignment as a *minimum* consequence. Failure in the course and referral to the University Judiciaries may also occur. In short, academic dishonesty *in any form* will **not** be tolerated.

The University's policies concerning academic misconduct are discussed in detail in Chapter UWS 14 and Faculty Document No. 1686, which can be found at the following URL: http://www4.uwm.edu/acad_aff/policy/academicmisconduct.cfm. I encourage you to examine this document.

Course Structure:

For *graduate* students, the overall grade for this course will be determined from the performance on five tasks, weighted as follows:

Exam I……	20%
Exam II……..	20%
Exam III…….	20%
Oral presentation……	20%
Written report…….	20%

For *undergraduate* students, an oral presentation will *not* be required, so the course grade will be determined as follows:

Exam I……	25%
Exam II……..	25%
Exam III…….	25%
Written report…….	25%

The first hourly exam will be given on Tuesday, February 27th, the second on Thursday, April 5th and the third during the Final Exam period, which is scheduled for Friday, May 18th, 2018 at 7:30 AM. *The first two of these dates should be regarded as tentative, and will be adjusted (with adequate advance notice) as progress in the lectures dictates. The schedule for final examinations is set by the University and cannot be changed.* All exams will be administered in the regular lecture room.

Written report guidelines:

Topic: To be selected by the student in consultation with the instructor (*e.g.*, Quality control for Tc-99m radiopharmaceuticals)

Length: *Graduate students*: 10-15 pages (double-spaced)
Undergraduate students: 7-10 pages (double-spaced)

Format: Flexible, but should contain information concerning four areas:

- Background / statement of problem
- Concise overview (historical) of research progress in the area
- Current research activities in the area
- Possible future directions

For additional information, please refer to D2L for representative examples of a written report.

Oral presentation guidelines:

Topic: Same as written report *(Deadline for topic selection: March 1, 2018)*

Length: 15-17 minutes + 2-3 minutes for questions

Format: Flexible – chalk talk, overheads, PowerPoint or any combination thereof

Dates: Tuesday, May 8, 2016; Thursday, May 10, 2018

Order of speakers: TBD

Time Commitment

Obviously no two students can be expected to devote precisely the same amount of time to satisfying the requirements of this course. Nonetheless a certain minimum time commitment can reasonably be anticipated. In addition to the 2.5 hour/week devoted to lectures, students should expect to spend a roughly equivalent amount of time each week reading to clarify and supplement the lectures. In addition, preparation for each of the three examinations can be expected to require several days of intensive study and review. Also, the written report, which requires extensive literature searching, will likely require a significant (8+ hour) weekly time commitment. Lastly, preparation of an oral presentation based upon the written report is expected to take several (3-5) days of concentrated effort.

Overview of Lecture Topics:

Origins of Nuclear Science
Nuclear Mass and Stability
Unstable Nuclei
Fundamentals of Radioactive Decay
Radionuclides in Nature
Transuranium Elements
Interaction of Matter and Radiation
Radiation Protection
Detection and Measurement Techniques
Separation and Determination of Radionuclides
Analytical Applications of Nuclear Reactions and Radioactive Materials

Guest Lectures

Note: The number, arrangement, date(s), topics, and presenters of these lectures are subject to change.

April ??: Topic: "TBD"
Dr. Michael Kaminski
Nuclear Forensics and Nanoscale Engineering Group
Nuclear Engineering Division, Argonne National Laboratory

April ??: Topic: "TBD"
Dr. Mark Antonio
Heavy Elements Chemistry & Chemical Separations Group
Chemical Sciences & Engineering Division, Argonne National Laboratory

The Literature of Nuclear and Radiochemistry:

- The Journal of Radioanalytical and Nuclear Chemistry
- Radiochimica Acta
- Solvent Extraction and Ion Exchange
- Separation Science and Technology
- The Journal of Nuclear Medicine
- Applied Radiation and Isotopes
- Health Physics
- Reactive and Functional Polymers
- Industrial and Engineering Chemistry Research
- Analytical Chemistry
- Analytica Chimica Acta
- Chemistry of Materials
- Journal of Materials Chemistry
- Inorganic Chemistry
- Advanced Materials
- Environmental Science and Technology
- Progress in Nuclear Energy
- Journal of Nuclear Materials
- Journal of the Chemical Society – Dalton Transactions
- Nuclear Technology
- Journal of Nuclear and Radiochemical Sciences
- Radiochemistry
- Journal of Nuclear and Radiochemistry