CHEM 4760 – Radiochemistry: Energy, Medicine, and the Environment (3 s.h.)
Spring 2022

Lecture Times: 9:30-10:20 am, Mon/Wed/Fri
Lecture Location: W55 Chemistry Building

Instructor: Prof. Korey Carter (he/him) e-mail: korey-carter@uiowa.edu

Office hours (Zoom) for Prof. Carter: Wed. 10:30 a.m. – 12:00 p.m. and Thurs. 3:00 p.m. – 4:30 p.m. (Zoom Meeting ID: 947 072 1740; Password: 577189103)

If these times do not work for your schedule, times are available outside office hours by appointment.

TA: James Earl e-mail: james-earl@uiowa.edu

Office hours: Tues. and Thurs. 9:30 – 10:30 a.m. in E208 Chemistry

Delivery Mode
Lectures will be in-person, and I strongly encourage attendance. However, if you are sick or cannot attend, the lectures will also be available on Zoom (Zoom Meeting ID: 965 6360 7915; Password: 577189103; https://uiowa.zoom.us/j/96563607915?pwd=eXpSRTNiMkpDOVNYelRGRFlpSGpCdz09). Recordings of the Zoom lectures are made via UI Capture and these will be posted on the ICON course website as they become available.

In-Class Expectations – Covid-19
The University of Iowa strongly encourages students, faculty, and staff to be vaccinated against COVID-19. The university also encourages students, faculty, and staff to wear a face mask while on campus, and strongly encourages the use of face masks in all classroom settings. However, face mask usage is not required except on CAMBUS and in specified research and healthcare settings.

If you are sick, please stay home. Information about how to get tested for Covid-19 and self-report a positive test result can be found at the following link https://coronavirus.uiowa.edu.

Course Description
This course is designed to provide fundamental theoretical concepts and calculations that are core to all aspects of radiochemistry within a framework of real-world applications. Students will be introduced to the chemical and physical phenomena that describe nuclear interactions, decay modes, isotope effects, and radioanalytical measurement technologies and gain insights into the impact these phenomena have for applications of radiochemistry and nuclear science in medicine, energy, industry, natural sciences, government, and for society.

Course Materials

Modern Nuclear Chemistry, Second Edition by Loveland, Morrissey, and Seaborg (available as e-book from Ulowa Library)

Course web site: (https://icon.uiowa.edu/) This site has the course syllabus, announcements, textbook chapters, lecture slides, problem sets, and grades.
Grading:

1) **6 Problem Sets** @ 50 points each = **300 points**
2) **Technical Writing Assignment** = **200 points**
3) **2 Midterm Exams** @ 150 points each = **300 points**
4) **Comprehensive Final Exam** = **200 points**

**Total = 1000 points**

The final grade distribution will be the following: 88% and above A; 75% and above B; 60% and above C; 50% and above D; below 50% F. +/- marks will be given at the end of the course. The instructor reserves the right to lower the grade cut-off but it will not be increased for any reason.

**Problem Sets**
Six graded problem sets (50 points each) will be given during the semester. Problem sets may be discussed, but all written work must be performed independently. Problem sets will be submitted electronically via ICON and are due *at the beginning of class* on assigned due dates.

**Exams**
There will be two in-class midterm exams of equal weight (150 points each) and there will be one final exam worth 200 points that will be cumulative. Mid-term exam dates are listed on the class assignment schedule and the final exam date and time will be announced during the fifth week of the semester. Make-up exams will be given only for excused absences or documented medical reasons. Please contact Prof. Carter (korey-carter@uiowa.edu) before the missed exam.

**Notes on Late Work, Independent Work, and Grading**

All assignments are due *at the beginning of class*. Late assignments will be penalized at 10% per day.

General discussion with classmates on the problem sets and the technical writing assignment is encouraged; however, students are expected to follow the University of Iowa Code of Academic Honesty. Instances of academic dishonesty will be reported to College of Liberal Arts and Sciences and the student may be placed on disciplinary probation for the remainder of their time at the University of Iowa. If a student is determined to have been academically dishonest on a problem set, exam, or writing assignment, the student will receive a zero (0) on the assignment.

Examples of academic dishonesty include *but are not limited to* the following:
- Copying from another student during an in-class exam or the final
- Copying from the primary published literature in your technical writing assignment
- Altering a graded exam and handing it back for regrade

Any questions about grades and scores received for course assignments should be directed to Prof. Carter. Requests for a regrade on a problem set or exam must be submitted by email with a written explanation within two weeks of the return date. When making a request for a re-grade, please note that I will re-grade the entire assignment. Federal privacy rules mandate that individual scores and grades cannot be publicly posted. Grades will be posted on ICON after each problem set and each exam and individual cumulative scores may be obtained from Prof. Carter.
ATTENDANCE AND CLASSROOM EXPECTATIONS
Students are responsible for attending class and for knowing an instructor’s attendance policies, which vary by course and content area. All students are expected to attend class and to contribute to its learning environment in part by complying with University policies and directives regarding appropriate classroom behavior or other matters.

ABSENCES
Students are responsible for communicating with instructors as soon they know that an absence might occur or as soon as possible in the case of an illness or an unavoidable circumstance. Students can use the CLAS absence form to help communicate with instructors who will decide if the absence is excused or unexcused; the form is located on ICON within the top banner under "Student Tools.” Delays by students in communication with an instructor could result in a forfeit of what otherwise might be an excused absence (https://clas.uiowa.edu/students/handbook/attendance-absences).

ABSENCES: ILLNESS, UNAVOIDABLE CIRCUMSTANCES, AND UNIVERSITY SPONSORED ACTIVITIES
Students who are ill, in an unavoidable circumstance affecting academic work, or who miss class because of a University sponsored activity are allowed by UI policy to make up a missed exam. Documentation is required by the instructor except in the case of a brief illness. Students are responsible for communicating with instructors as soon as the absence is known (https://opsmanual.uiowa.edu/students/absences-class#8.1).

ABSENCES: HOLY DAYS
The University is prepared to make reasonable accommodations for students whose religious holy days coincide with their classroom assignments, test schedules, and classroom attendance expectations. Students must notify their instructors in writing of any such Religious Holy Day conflicts or absences within the first few days of the semester or session, and no later than the third week of the semester. If the conflict or absence will occur within the first three weeks of the semester, the student should notify the instructor as soon as possible. See Operations Manual 8.2 Absences for Religious Holy Days for additional information.

ABSENCES: MILITARY SERVICE OBLIGATIONS
Students absent from class due to U.S. veteran or U.S. military service obligations (including military service-related medical appointments, military orders, and National Guard Service obligations) must be excused without penalty. Instructors must make reasonable accommodations to allow students to make-up exams or other work. Students must communicate with their instructors about the expected possibility of missing class as soon as possible. (For more information, see https://opsmanual.uiowa.edu/iv-8-absences-class%20absences).

ACADEMIC MISCONDUCT
All undergraduates enrolled in courses offered by CLAS have in essence agreed to the College's Code of Academic Honesty. Academic misconduct affects a student's grade and is reported to the College which applies an additional sanction, such as suspension. Outcomes about misconduct are communicated through UI email (https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code). Plagiarism and the process for addressing academic misconduct of graduate students are defined in Section IV, Article F “Plagiarism by Graduate Students” of the UI Graduate College Manual of Rules and Regulations. Please contact the CLAS Associate Dean for Graduate Education for any necessary assistance in navigating the process mandated by the Graduate College.

ACADEMIC ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES
The University is committed to providing an educational experience that is accessible to all students. If a student has a diagnosed disability or other disabling condition that may impact the student’s ability to complete the course requirements as stated in the syllabus, the student may seek accommodations through Student Disability Services (SDS). SDS is responsible for making Letters of Accommodation (LOA)
available to the student. The student must provide a LOA to the instructor as early in the semester as possible, but requests not made at least two weeks prior to the scheduled activity for which an accommodation is sought may not be accommodated. The LOA will specify what reasonable course accommodations the student is eligible for and those the instructor should provide. Note that accommodations are not granted retroactively but from the time of the student’s request to the instructor onward. Additional information can be found on the SDS website. Note that accommodations are not granted retroactively but from the time of the student’s request to the instructor onward. Graduate students serving as Teaching Assistants, Research Assistants, or Fellows must contact Faculty and Staff Disability Services (https://hr.uiowa.edu/support/faculty-and-staff-disability-services) for assistance with accommodations.

CLASS RECORDINGS: PRIVACY AND SHARING
Course lectures and discussions are sometimes recorded or live-streamed. These are only available to students registered for the course and are the intellectual property of the faculty member. These materials may not be shared or reproduced without the explicit written consent of the instructors. Students may not share these recordings with those who are not enrolled in the course; likewise, students may not upload recordings to any other online environment. Doing so is a breach of the Code of Student Conduct and could be a violation of the Federal Education Rights and Privacy Act (FERPA); also see https://dos.uiowa.edu/policies/code-of-student-life/.

COMMUNICATION: UI EMAIL
Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community (Operations Manual, III.15.2). Emails should be respectful and brief, with complex matters addressed during the instructor’s drop-in hours, for example. Faculty are not expected to answer email after business hours or during the weekends.

COMPLAINTS ABOUT ACADEMIC MATTERS
Students with a complaint about a grade or a related academic issue should first visit with the instructor and then with the course supervisor (if one is assigned), and next with the Chair of the department or program offering the course. If not resolved, students may bring their concerns to the College of Liberal Arts and Sciences: https://clas.uiowa.edu/students/handbook/student-rights-responsibilities. If a graduate student has not been able to resolve the issue through the director of the school, department, or program, they should contact the associate dean for graduate education in the College of Liberal Arts and Sciences.

FINAL EXAMINATION POLICIES
The final exam schedule is published during the fifth week of the fall and spring semesters or on the first day of summer classes; students are responsible for knowing the date, time, and place of their final exams. Students should not make travel plans until knowing this information. A student with exams scheduled on the same day and time or who have more than two final exams on the same day should visit this page for how to resolve these problems by the given deadline: https://registrar.uiowa.edu/makeup-final-examination-policies. No exams may be scheduled the week before finals; some exception, however, have been made for labs, language courses, and off-cycle courses (https://registrar.uiowa.edu/final-examination-scheduling-policies).

FREE SPEECH AND EXPRESSION
The University of Iowa supports and upholds the First Amendment protection of freedom of speech and the principles of academic and artistic freedom. We are committed to open inquiry, vigorous debate, and creative expression inside and outside of the classroom. Visit Free Speech at Iowa for more information on the University’s policies on free speech and academic freedom: https://freespeech.uiowa.edu/.

HOME OF THE COURSE
The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the course’s add and drop deadlines, the “second-grade only” option (SG0), and other undergraduate policies and procedures. Different UI colleges may have other policies or deadlines. See https://clas.uiowa.edu/students/handbook. Questions? Contact CLAS at clasps@uiowa.edu or 319-335-
2633. Graduate students, however, must adhere to the academic deadlines set by the Graduate College. See [https://grad.uiowa.edu/academics/deadlines](https://grad.uiowa.edu/academics/deadlines).

**MENTAL HEALTH**

Students are encouraged to be mindful of their mental health and seek help as a preventive measure or if feeling overwhelmed and/or struggling to meet course expectations. Students are encouraged to talk to their instructor for assistance with specific class-related concerns. For additional support and counseling, students are encouraged to contact University Counseling Service (UCS). Information about UCS, including resources and how to schedule an appointment, can be found at [counseling.uiowa.edu](http://counseling.uiowa.edu). Find out more about UI mental health services at: [mentalhealth.uiowa.edu](http://mentalhealth.uiowa.edu). Student Health can also address related concerns ([https://studenthealth.uiowa.edu/](https://studenthealth.uiowa.edu/)). These visits are free to students. After hours, students are encouraged to call the Johnson County Community Crisis Line at (319) 351-0140 or dial 911 in an emergency.

**NON-DISCRIMINATION STATEMENT**

The University of Iowa prohibits discrimination in employment, educational programs, and activities on the basis of race, creed, color, religion, national origin, age, sex, pregnancy, disability, genetic information, status as a U.S. veteran, service in the U.S. military, sexual orientation, gender identity, associational preferences, or any other classification that deprives the person of consideration as an individual. The university also affirms its commitment to providing equal opportunities and equal access to university facilities. For additional information on nondiscrimination policies, contact the Director, Office of Institutional Equity, the University of Iowa, 202 Jessup Hall, Iowa City, IA 52242-1316, 319-335-0705, [oie-ui@uiowa.edu](mailto:oie-ui@uiowa.edu). Students may share their pronouns and chosen/preferred names in MyUI, which is accessible to instructors and advisors.

**SEXUAL HARASSMENT**

The University of Iowa prohibits all forms of sexual harassment, sexual misconduct, and related retaliation. The [Policy on Sexual Harassment and Sexual Misconduct](http://policy.uiowa.edu/victims/resources) governs actions by students, faculty, staff and visitors. Incidents of sexual harassment or sexual misconduct can be reported to the Title IX and Gender Equity Office or to the Department of Public Safety. Students impacted by sexual harassment or sexual misconduct may be eligible for academic supportive measures and can learn more by contacting the Title IX and Gender Equity Office. Information about confidential resources can be found here. Watch the video for an explanation of these resources.
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| January 21 – January 31 | **Introduction to Radiochemistry**  
The basics of radiochemistry: Atoms, nuclear stability, radioactive decay (α, β, γ), parent/daughter relationships. | Chapters 2-5-Choppin          |
| February 2 - 7      | **Radioactive Decay Kinetics and Radiation Detection**  
Principles of secular and transient equilibrium as well as α, β, γ, decay detection, signal transduction and output, and data analysis. | Chapter 8-Choppin  
Chapters 3, 16, and 17-Loveland |
| February 11 – 21    | **The Nuclear Fuel Cycle**  
The origin of elements, an introduction to the actinides, and an exploration into nuclear power generation from uranium ore to energy production and waste. | Chapters 12, 14, and 19-21-Choppin  
Chapters 11, 14, and 15-Loveland |
| February 23         | **MID-TERM EXAM #1**                                                           |                                 |
| February 25 – March 4| **Environmental Radiochemistry**  
Introduction to environmental radiochemistry of lanthanides, actinides, transition metals, and radon. | Chapters 13 and 22-Choppin |
| March 7 – 11        | **Isotope Production**  
Introduction to production reactors, accelerators, reactions, cross sections, targets. | Chapters 10, 11, 16, and 17-Choppin  
Chapters 10 and 13-Loveland |
| March 14 – 18       | **SPRING BREAK**                                                               | Chapters 10, 11, 16, and 17-Choppin  
Chapters 10 and 13-Loveland |
| March 21 – 25       | **Isotope Production (cont.)**                                                 | Chapters 10 and 13-Loveland |
| March 28 – April 11 | **Radiochemical Separations**  
Details regarding chemical separations as they apply to the analysis and use of nuclear material in medicine and forensics. | Chapters 17, 18, and Appendix A-Choppin |
| April 13            | **MID-TERM EXAM #2**                                                           |                                 |
| April 15 – May 2    | **Radiosynthesis and Radiopharmaceuticals**  
Introduction to organic synthesis of radionabeled compounds and radiochemicals. | Chapter 15-Choppin  
Chapter 4-Loveland |
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