

Course Information for CHEM 522, Radiochemistry Laboratory

Prerequisites: CHEM 221, CHEM 331 and PHYSICS 202 or equivalent

The goal of this course is to provide instruction in laboratory methods in radiochemistry and nuclear chemistry, including experimental design which incorporates use of radioactive material and radiation detection instruments. The course will include principles and practices of radiation detection, safe handling of radioactive materials and methods of incorporation of radiochemistry or nuclear chemistry into research projects.

Meeting Schedule

Meeting day and time: Tuesday 1:10 p.m. – 4:10 p.m.

Meeting Place: Dodgen Research Facility

This course will meet at the regularly scheduled time, however students who need additional time to complete their work may do so outside of the regularly scheduled class meeting time. Additional time may be scheduled by contacting either Dr. D. Wall, Diana Tabada or Chris Musa.

Instructor Information

Dr. Donald Wall

Nuclear Radiation Center

Dodgen Research Facility

Office Hours: By appointment only

Contact information: donald.wall@wsu.edu
335-8641

WSU NRC Staff Assistants:

Diana Tabada

Chris Musa

Office hours: By appointment only

Contact information: diana_lightfoot@wsu.edu
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335-8641

Teaching Assistant

Mitchell Friend mitchell.friend@wsu.edu

Textbook and Course Materials:

Course materials will be distributed as pdf files.

Learning Outcome(s) for CHEM 522

The purpose of this course is to provide instruction in laboratory methods in radiochemistry and nuclear chemistry. This will include the development of proficiency in use of nuclear radiation detectors and experimental design.

Course Structure and Schedule

As this is a graduate-level course, students will be allowed to set their own schedule and own pace to some extent. For example, the number of instruments available for the class is limited and consequently it is not possible to accommodate all of the students in the class on the same instruments at the same time. Therefore, it is not required to carry out the experiments/exercises in the order that is listed in the Topic Schedule. The schedule flexibility will allow the class to maximize the use of the laboratory space and instrumentation. The individual student has responsibility to complete the laboratory work and prepare reports in a timely manner.

A minimum of one laboratory report per week must be submitted. The first six required reports should be submitted in the order listed on the class schedule. After that, the optional reports may be submitted in any order, as long as at least one report per week is submitted. You may work ahead if you prefer.

Submittal of Assignments, Reports, etc.

All assignments must be submitted electronically via e-mail unless otherwise noted.

Required Experiments, Optional Experiments and Special Projects

There is a list of six required experiments that each person must carry out. After completion of the six required experiments each person will have a choice of direction of either Track 1 or Track 2 for the rest of the course.

All of the first six assignments and all of the eight assignments of Track 1 are to be conducted and submitted independently, i.e. without collaboration with another person in carrying out the experiment or report writing.

Required Experiments
Characteristics of Geiger-Muller Detectors
Characteristics of NaI(Tl) Well Counters
Characteristics of HPGe detectors
Alpha-particle spectrometry
Beta particle backscatter
Characteristics of Liquid Scintillation Counters

Track 1: Choose eight experiments from the list in the Track 1 Experiments table,

Or

Track 2: Carry out a special project. See below.

Expt. Number	Track 1 Experiments
1	Determining the reaction cross-section for a nuclear reaction
2	Fission product yield for U fission
3	Determining the trace element composition of a sample by NAA
4	Measuring the mass/linear attenuation coefficient for gamma rays in air
5	The Szilard-Chalmers reaction
6	Epithermal and fast neutron induced reactions
7	NORM: Naturally Occurring Radioactive Material in the environment, e.g. surface waters, soils, construction materials, masonry, etc.
8	Compton scattering angles
9	Using NORM to Calibrate Nuclear Radiation Detectors
10	Ladies and Gentlemen: Introducing the $^{137}\text{Cs}/^{137\text{m}}\text{Ba}$ Generator
11	Coprecipitation as a Chemical Separation Method
12	Preparation of a Reactor-Produced Carrier-free Sample: ^{18}F
13	Separation of a Radioactive Daughter from a Parent by Solvent Extraction: the Actinides
14	Electrodeposition of U and α -spectroscopy determination of U enrichment
15	Determination of the K_{sp} of sparingly soluble salts
16	Isotope dilution analysis
17	Preparation of a carrier added and carrier free sample: the $^{56}\text{Fe}/^{56}\text{Mn}$ Production Reactions or the $^{130}\text{Te}/^{131}\text{I}$ system
18	Electrodeposition of Cu – determination of the thickness of an electrodeposited sample, detector efficiency and sample self-absorption
19	Determination of the absolute efficiency for GM, NaI, HPGe, LSC
20	Use HPGe to find attenuation coefficients for metals

Track 2.

This track is based on a short, independent project. The intent is to carry out a special project which is approximately equal in scope to the time and effort required to carry out the eight optional experiments. If you choose Track 2, I will help you define and design a suitable research project and provide some guidance in carrying out the project.

Two students may collaborate as a pairs on a Track 2 project and submit a single report. However, it is not *required* to collaborate, and a single person may carry out a Track 2 project without a collaborator.

Week number	Week of:	Topic Schedule
1	January 9	First week of class
2	January 16	Report 1 due
3	January 23	Report 2 due
4	January 30	Report 3 due
5	February 6	Report 4 due
6	February 13	Report 5 due
7	February 20	Report 6 due
8	February 27	Report 7 due (Track 1)
9	March 6	Report 8 due (Track 1)
10	March 13	Spring Break (Track 1)
11	March 20	Report 9 due (Track 1)
12	March 27	Report 10 due (Track 1)
13	April 3	Report 11 due (Track 1)
14	April 10	Report 12 due (Track 1)
15	April 17	Report 13 due (Track 1)
16	April 24	Report 14 due (Track 1)
17	May 1	Final report for Track 2 due

Everyone is expected to complete the experiments/exercises on the course schedule. Additional laboratory time may be scheduled for those people who are not able to complete the work during the regularly scheduled time.

There will be 14 laboratory reports. There will not be either mid-term or final examinations. Evaluation of the learning outcome will be done by means of laboratory reports.

Grading Policy

Track 1 Grading. Grades will be based upon performance on the laboratory exercises. All laboratory exercises will be weighted the same, i.e. each assignment will count as 1/14 in terms of contribution to the course grade

Course activity	Percent of grade
Each of 14 laboratory exercises	7.14 % per report
Total	100

Track 2 Grading. The first six laboratory reports will count as 6/14 of the course grade. The remainder of the course grade will be determined by the performance on the independent project.

Course activity	Percent of grade
Laboratory exercises, 1 - 6	42.6 %
Individual project	57.4%

Track 2 Publication Option: Some Track 2 projects may be suitable for publication in a professional journal. A project that meets the standard for publication (i.e. original scientific contribution, completeness, appropriate experimental procedures and controls, etc.) in a professional journal will earn an “A” for the course, *provided that reports 1 – 6 have also been submitted.* In this Publication Option, I will actively assist you in the writing, editing and preparation etc. of a manuscript for publication.

Letter grade equivalencies are as follows:

Percentage	Grade
93 – 100	A
90 – 93	A-
87 – 90	B+
83 – 87	B
80 – 83	B-
77 – 80	C+
73 – 77	C
70 – 73	C-
67 – 70	D+
63 – 67	D
60 – 63	D-
< 60	F

Due Dates

One laboratory report will be due each week, by noon Friday. The first six laboratory reports will be due in their respective order. You may turn in more than one report per week, although I encourage you to turn in only the first report on the week of January 16. This will allow me to make comments on the reports, which can be incorporated into future reports. The particular laboratory report for the optional Track 1 that is due on a particular week will vary from person to person according to the choices they make. Nevertheless, a minimum of one report per week must be submitted by each student.

Late Assignments

Assignments will not be accepted after the due date unless prior arrangements have been made. A score of zero will be assigned for each week that a report is not submitted

Attendance Policy

Students are expected to attend class, but will not be penalized in terms of grading for missing class. However, students who miss class on a particular week will not be permitted to schedule "make-up" sessions during that week.

Reasonable Accommodation

Students with Disabilities: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations must be approved through the Access Center. For more information contact a Disability Specialist <http://accesscenter.wsu.edu>, or Access.Center@wsu.edu

Academic Integrity Policy

The following statement comes from the WSU policy on academic integrity:

Academic integrity will be enforced in this course. A student caught cheating on an assignment will receive an F grade for the course, will not have the option to withdraw from the course and will be reported to the Office of Student Standards and Accountability. Cheating is defined in the Washington Administrative Code, WAC 504-26-010 (3):

(3) The term "cheating" includes, but is not limited to:

- (a) Use of unauthorized materials in taking quizzes, tests, or examinations, or giving or receiving unauthorized assistance by any means, including talking, copying information from another student, using electronic devices, or taking an examination for another student.
- (b) Use of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments.
- (c) Acquisition or possession of tests or other academic material belonging to a member of the university faculty or staff when acquired without the permission of the university faculty or staff member.
- (d) Fabrication, which is the intentional invention or counterfeiting of information in the course of an academic activity. Fabrication includes, but is not limited to:
 - (i) Counterfeiting data, research results, information, or procedures with inadequate foundation in fact;

- (ii) Counterfeiting a record of internship or practicum experiences;
 - (iii) Submitting a false excuse for absence or tardiness or a false explanation for failing to complete a class requirement or scheduled examination at the appointed date and time.
- (e) Engaging in any behavior for the purpose of gaining an unfair advantage specifically prohibited by a faculty member in the course syllabus or class discussion.
- (f) Scientific misconduct. Falsification, fabrication, plagiarism, or other forms of dishonesty in scientific and scholarly research are prohibited. Complaints and inquiries involving cases of scientific misconduct are managed according to the university's policy for responding to allegations of scientific misconduct. A finding of scientific misconduct is subject to sanctions by the office of student conduct. The policy for responding to allegations of scientific misconduct may be reviewed by contacting the office of research.
- (g) Unauthorized collaboration on assignments.
- (h) Intentionally obtaining unauthorized knowledge of examination materials.
- (i) Plagiarism. Presenting the information, ideas, or phrasing of another person as the student's own work without proper acknowledgment of the source. This includes submitting a commercially prepared paper or research project or submitting for academic credit any work done by someone else. The term "plagiarism" includes, but is not limited to, the use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.
- (j) Unauthorized multiple submission of the same work.
- (k) Sabotage of others' work.
- (l) Tampering with or falsifying records.