

HPS 403/603

Radiation Physics & Instrumentation Laboratory

Syllabus

Spring 2017

Instructor: Dr. Carson Riland

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Office Hours: Monday & Wednesday 3:00 - 4:00 PM
Thursday 1:00 – 2:00 PM
& by appointment

Pre/co-requisite: HPS 402/602

Description: Laboratory experiments in radiation physics and detection
Operation of radiation detection instrumentation
Introduction into practical spectroscopy

Schedule	Section I: Monday	11:00 – 2:30	BHS 117
	Section II: Wednesday	11:00 – 2:30	BHS 117

Recommended Textbook

Knoll, G. F., *Radiation Detection and Measurement*, 4th Edition, John Wiley (2010)

Supplemental Textbooks

Tsoufanidis, N., Landsberger, S., *Measurement and Detection of Radiation*, 3rd Edition, CRC Press (2010)

Ahmed, S.N., *Physics & Engineering of Radiation Detection*, 2nd Edition, Elsevier (2014)

L'Annunziata, M.F., *Handbook of Radioactivity Analysis*, 3rd Edition, Academic Press (2012)

Gilmore, G., *Practical Gamma-Ray Spectrometry*, 2nd Edition, John Wiley (2008)

Turner, J.E., Downing, D.J., Bogard, J.S., *Statistical Methods in Radiation Physics*, Wiley-VCH (2012)

Teaching Methods

Practical laboratory experiments
Problem solving in groups and as individuals

Evaluation Methods

Accomplishment of course objectives will be assessed by completing the following tasks:

	HPS 403	HPS 603
Pre-Laboratory Quiz	10%	10%
Laboratory Notebook	10%	10%
Laboratory Reports	60%	60%
Final Exam	20%	20%

Grading Scale

Letter grades for this class will be based on the following grading scale:

Grade Points	Letter Grade
≥ 93	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
60-69	D
< 60	F

Course Objectives

The student is expected to gain an understanding of the handling and application of a variety of radiation detectors. The student will be able to operate a variety of radiation detectors independently, and to handle other aspects of the measurements, such as the use of shielding and the choice of appropriate counting times. The knowledge gained by the student in this course can be applied to the daily professional activities of a practicing radiochemist, nuclear engineering, health or medical physicist. After successful completion of this class the student is expected to be able to perform the activities listed below:

1. Operate an oscilloscope and use it to monitor signals from a radiation detector and the associated electronics.
2. Become familiar with the function of different types of nuclear instrumentation, such as preamplifiers, amplifiers, single channel analyzers, ADC's.
3. Set up the electronic modules necessary to process signals from radiation detectors.
4. Operate a variety of radiation detectors, such as gas proportional counters, Geiger-Mueller counters, sodium iodide detectors, high-purity germanium detectors and surface barrier detectors.
5. Use a liquid scintillation counter.
6. Understand the uncertainties associated with radiation and decay measurements and be able to calculate the error of measurements.

7. Determine the absorption coefficients for different types of material and apply this knowledge for radiation shielding.

Quiz

Students are expected to prepare for each class by reading the notes for each experiment in advance. Weekly quizzes will be given at the beginning of each class to test the student's knowledge of the experiment planned for that day.

Laboratory Notebooks

Students are expected to obtain a bound notebook with numbered pages to use as a laboratory notebook. Several pages should be left blank at the beginning for a table of contents. All work should be clearly labeled with the date noted for the start of each lab. Tape any computer printouts or graphs directly into your logbook. Perform all calculations required during class in the logbook.

Laboratory Reports

Students are expected to document the results of each class by writing a laboratory report. The reports are due one week after the experiment was performed. The report should contain the following:

- A cover page listing the title of the laboratory, the date at which the experiments were conducted and the name of the persons conducting the experiments.
- A statement describing the purpose of the laboratory
- An introduction explaining operation of the detectors used and the theoretical basis for the experiments if appropriate.
- An experimental section stating the instruments used and describing the procedures followed.
- A results section containing the raw data from the experiment, any calculations performed including the formula used and the results obtained.
- A short section describing the conclusions of the experiments conducted.

Reports should be prepared using a word processor and printed on letter size paper. Unless stated otherwise, the results should be given in S.I. units. No result section is considered complete without error calculations or error discussion.

Exam

Final examination will consist of individual oral exams of 20 minute duration. The exam will cover the theory behind the detectors utilized and the experiments conducted, as well as the methods used and the results obtained. Students are expected to know the material well. Appointments for the exam will be scheduled with the instructor during the finals period.

Academic Misconduct

Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of

the Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution.

An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the Student Academic Misconduct Policy (approved December 9, 2005) located at: <http://studentconduct.unlv.edu/misconduct/policy.html>.

Copyright

The University requires all members of the University Community to familiarize themselves and to follow copyright and fair use requirements. You are individually and solely responsible for violations of copyright and fair use laws. The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws. Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at:

<http://www.unlv.edu/committees/copyright/>.

Disability Resource Center (DRC)

The UNLV Disability Resource Center (SSC-A 143, <http://drc.unlv.edu/>, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you.

If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to me during office hours so that we may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach me before or after class to discuss your accommodation needs.

Religious Holidays Policy

Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor no later than the end of the first two weeks of classes, September 6, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. This policy shall not apply in the event that administering the test or examination at an alternate time would impose an undue hardship on the instructor or the university which could have been avoided. For additional information, please visit:

<http://catalog.unlv.edu/content.php?catoid=4&navoid=164>.

Incomplete Grades

The grade of I – Incomplete – can be granted when a student has satisfactorily completed all course work up to the withdrawal date of that semester/session but for reason(s) beyond the student's control, and acceptable to the instructor, cannot complete the last part of the course,

and the instructor believes that the student can finish the course without repeating it. A student who receives an I is responsible for making up whatever work was lacking at the end of the semester. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

Tutoring

The Academic Success Center (ASC) provides tutoring and academic assistance for all UNLV students taking UNLV courses. Students are encouraged to stop by the ASC to learn more about subjects offered, tutoring times and other academic resources. The ASC is located across from the Student Services Complex, #22 on the current UNLV map. Students may learn more about tutoring services by calling (702) 895-3177 or visiting the tutoring web site at: <http://academicsuccess.unlv.edu/tutoring/>.

UNLV Writing Center

One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance.

Appointments may be made in person or by calling 895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>.

Rebelmail

By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's Official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu.

Tentative Outline of Instruction

Week 1	Introduction & Safety Training
Week 2	Laboratory #1: Oscilloscope Usage
Week 3	Laboratory #2: Radiation and Contamination Surveys
Week 4	Laboratory #3: Counting statistics & Distance Law
Week 5	No Class
Week 6	Laboratory #4: Absorption of Beta and Gamma Rays
Week 7	Laboratory #5: Geiger-Mueller Counter
Week 8	Laboratory #6: Liquid Scintillation Counting
Week 9	Laboratory #7: Spectroscopy using a NaI Detector with SCA
Week 10	Laboratory #8: Spectroscopy using a NaI Detector with MCA
Week 11	Laboratory #9: Alpha Spectrometry
Week 12	Laboratory #10: Measurement of Radon Daughters
Week 13	Spring Break Recess
Week 14	Laboratory #11: Gamma-Ray Spectroscopy using a HPGe Detector
Week 15	Laboratory #12: Gamma-Ray Spectroscopy on Environmental Samples
Week 16	Study Week - Make Up – Unique Applications
Week 17	Final Exam