

HPS 602

Radiation Detection

Syllabus

Spring 2017

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

Prerequisite: HPS 402: HPS 300 or consent of instructor
HPS 602: HPS/RDCH 701 or consent of instructor

Description: Principles of radiation detection and measurement
Introduction to nuclear spectrometry and instrumentation
Counting statistics and data interpretation

Schedule Monday & Wednesday 10:00 – 11:15 AM Room BHS 210

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*, 2nd Edition, Academic Press (2003)
Gilmore, G., *Practical Gamma-Ray Spectrometry*, John Wiley (2008)
Turner, J.E., Downing, D.J., Bogard, J.S., *Statistical Methods in Radiation Physics*, Wiley-VCH (2012)

Teaching Methods

Lectures with handouts, slides and white board
Problem solving in groups and as individuals

Evaluation Methods

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

	HPS 402	HPS 602
Homework	30%	30%
Mid-Term Exam	20%	20%
Term Project	20%	25%
Final Exam	20%	25%

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 a basic understanding of the concepts and applications of radiation detection. The knowledge gained by the student in this course can be applied to the daily professional activities of a practicing radiochemist, nuclear engineer, health or medical physicist. After successful completion of this class the student is expected to be able to perform the activities listed below:

1. Explain the different radiation interaction mechanisms.
2. Use statistical methods to determine the uncertainty in measured values.
3. Combine uncertainties associated with radiation detection and sample preparation
4. Explain the general properties of radiation detectors/dosimeters typically found in the workplace.
5. Explain the operation of gas-filled radiation detectors and distinguish the appropriate type of instrument for a given application.
6. Explain the operation of scintillation and semiconductor detectors and distinguish the appropriate type of instrument for a given application.
7. Explain the operation and use of equipment used to detect slow and fast neutrons, and their limitations.
8. Explain the principles of gamma-ray and alpha spectrometry in analyzing the composition of radioactive samples.
9. Understand the signal processing associated with radiation detection.
10. List the sources of radiation backgrounds and design methods/components to reduce it.

Homework

Homework assignments will be typically be assigned each week. They may consist of problem sets, group assignments and/or “mini-projects”. Students need to submit the completed assignment at the next class meeting.

Exams

Examinations will consist of problem sets and short answer questions. Exams will be closed book. Students are expected to know the material well. Students must take each examination at the scheduled time. If a student is unable to take an examination at the scheduled time, the student must contact the course instructor in advance in writing to inform him that they will need to take the examination early. Failure to take an exam will result in a score of zero points for the exam. Students must take the final exam at the scheduled time without exception.

Term Project

Each student will be expected to complete a term project related to designing or explaining an advanced detection system that we may not fully discuss in class. Deliverables will be; an abstract proposal describing the project, a journal-style paper and a 15 minute presentation. HPS 603 students will further require at last one recent publication be referenced.

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 Student 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: <https://www.unlv.edu/studentconduct/student-conduct>.

Copyright

The University requires all members of the University Community to familiarize themselves **with** 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/provost/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 the instructor during office hours so that you 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 the instructor in front of others 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 within the first 14 calendar days of the course for fall and spring courses (excepting modular courses), or within the first 7 calendar days of the course for summer and modular courses, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit: <http://catalog.unlv.edu/content.php?catoid=6&navoid=531>.

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.

Transparency in Learning and Teaching

The University encourages application of the transparency method of constructing assignments for student success. Please see these two links for further information:

<https://www.unlv.edu/provost/teachingandlearning>

<https://www.unlv.edu/provost/transparency>

Tutoring and Coaching

The Academic Success Center (ASC) provides tutoring, academic success coaching and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, visit <http://www.unlv.edu/asc> or call 702-895- 3177. The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of the SSC (ASC Coaching

Spot). Drop-in tutoring is located on the second floor of the Lied Library and College of Engineering TEB second floor.

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 702-895-3908. 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. **Emailing within WebCampus is acceptable.**

Library Resources

By policy, Students may consult with a librarian on research needs. For this class, the subject librarian is https://www.library.unlv.edu/contact/librarians_by_subject. UNLV Libraries provides resources to support students' access to information. Discovery, access, and use of information are vital skills for academic work and for successful post-college life. Access library resources and ask questions at <https://www.library.unlv.edu/>.

Final Examinations

The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: <http://www.unlv.edu/registrar/calendars>.

Tentative Outline of Instruction

01/16/16	Martin Luther King Jr. Day Recess
01/18/16	Introduction/Radiation Sources
01/23/16	Radiation Interactions
01/25/16	Counting Statistics and Error Propagation
01/30/16	Counting Statistics and Error Propagation
02/01/16	Counting Statistics and Error Propagation
02/06/16	General Properties of Radiation Detectors
02/08/16	General Properties of Radiation Detectors
02/13/16	No lecture
02/15/16	No lecture
02/20/16	President's Day Recess
02/22/16	Ion Chambers
02/27/16	Ion Chambers/Proportional Counters
03/01/16	Proportional Counters/ Geiger Mueller Counters
03/06/16	Geiger Mueller Counters
03/08/16	Mid-Term Exam
03/13/16	Scintillation Detector Principles
03/15/16	Radiation Spectroscopy with Scintillators
03/20/16	Radiation Spectroscopy with Scintillators
03/22/16	Applications of Liquid Scintillation Counting
03/27/16	Applications of Liquid Scintillation Counting
03/29/16	Semiconductor Diode Detectors
04/03/16	Semiconductor Diode Detectors
04/05/16	Alpha Spectroscopy
04/10/16	Spring Break
04/12/16	Spring Break
04/17/16	Germanium Gamma-Ray Detectors
04/19/16	Germanium Gamma-Ray Detectors
04/24/16	Neutron Detection
04/26/16	Neutron Detection
05/01/16	Study Week
05/03/16	Study Week
05/08/16	10:10-12:10 Final Exam