

ME 757 Radiation Monitoring and Safeguards Systems

UNLV Department of Mechanical Engineering

Course Description

Includes advanced topics in radiation measurement science, remote sensing, nondestructive assay techniques, and nuclear material safeguards. Special emphasis is given to the use of radiation detection systems in process monitoring and safeguards, and in security applications.

Course Learning Outcomes

By the end of this course, students will have sufficient knowledge to accomplish the following:

- Describe different radiological and nuclear materials and methods of their production.
- Describe nuclear fuel cycles and isotope enrichment methods.
- Explain the physical processes in photon and neutron detectors.
- Analyze radioactive decay rates and compute the radionuclide concentrations.
- Solve nuclear and radiation detection problems.
- Employ gamma ray and neutron detection methods for passive assay of nuclear materials.
- Describe the operation of coincidence neutron and photon detection methods and multiplicity measurements.
- Explain operation principles of different pulse neutron and photon sources.
- Explain active interrogation methods for nuclear material assay.
- Describe remote radiation sensing methods.
- Describe different nuclear safeguards systems.
- Explain nuclear material accounting techniques.

Prerequisites

ME 455, [ME 655](#) or consent of instructor.

Required Text

Course materials will be provided by instructor.

Additional materials: G.F. Knoll, Radiation Detection and Measurement, 4th Edition (2011, John Wiley and Sons, Inc., ISBN: 978-0-470-13148-0).

Homework

Weekly homework assignments will be given out in class.

Students will be expected to complete the assignments and submit for grading following the one-week cycle. The assignments will include problem solving and system design for radiation monitoring and safeguards applications.

Grading

Two Midterm Exams (50%), Homework (10%), Project (10%), and Final Exam (30%). Midterm and Final exam grades will be posted on Webcampus. The course grade will be posted in the MYUNLV system on May 17th.

Final Grades:	90% and above	A
	80% to 89%	B
	70% to 79%	C
	60% to 69%	D
	59% and below	F

Course Schedule

Important: This schedule is subject to change. The instructor will inform you whenever this is the case.

Wk	Date	Topics (subject to change / adjust)	Reading	Homework
1	18-Jan	<i>NO CLASS – Martin Luther King Day Recess</i>		
	20-Jan	Introduction. Radiation measurements review.	L. 1	
2	25-Jan	Nuclear and radiological materials.	L. 2	
	27-Jan	Processing and enrichment of nuclear materials.	L. 3	HW1 posted
3	1-Feb	Nuclear fuel cycles. Plutonium production.	L. 4	
	3-Feb	Nuclear nonproliferation.	L. 5	HW1 due/HW2 posted
4	8-Feb	Nuclear safeguards. Safeguards by design.	L. 6	
	10-Feb	Nuclear materials accounting.	L. 7	HW2 due/HW3 posted
5	15-Feb	<i>NO CLASS - Washington's Birthday Recess</i>		
	17-Feb	Gamma-ray detection and spectroscopy.	L. 8	HW3 due/HW4 posted
6	22-Feb	Neutron detection and spectroscopy.	L. 9	
	24-Feb	Midterm Exam 1.		
7	29-Feb	Neutron and photon coincidence detection methods.	L. 10	
	2-Mar	Multiplicity measurements.	L. 11	HW4 due/HW5 posted
8	7-Mar	Passive assay of nuclear materials.	L. 12	
	9-Mar	Uranium enrichment measurements.	L. 14	HW5 due/HW6 posted
9	14-Mar	Plutonium isotopic composition measurements.	L. 15	
	16-Mar	Neutron and photon sources.	L. 16	HW6 due/HW7 posted
10	21-26 Mar	<i>NO CLASSES, NO LAB - Spring Break</i>		
11	28-Mar	Active assay of nuclear materials.	L. 17	
	30-Mar	Active assay of nuclear materials.	L. 17	HW7 due/HW8 posted
12	4-Apr	Midterm Exam 2.		
	6-Apr	Fresh and used nuclear fuel measurements.	L. 18	Projects issued
13	11-Apr	SNM monitoring.	L. 19	
	13-Apr	Safeguards systems.	L. 20	HW8 due/HW9 posted
14	18-Apr	Radiation portals.	L. 21	
	20-Apr	Imaging of nuclear materials.	L. 22	HW9 due/HW10 posted
15	25-Apr	Remote radiation sensing.	L. 23	
	27-Apr	Radiation detector networks.	L. 24	HW10 due
16	2-May	Nuclear security.	L. 25	
	4-May	Project presentations. Study week.		Projects due

Policies and Resources

Library Resources

- Students may consult with a librarian on research needs. For this class, the subject librarian is Sue Wainscott. (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>.

Policies:

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>.

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>

Incomplete Grades—The grade of I—Incomplete—can be granted when a student has satisfactorily completed three-fourths of course work for 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. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving “I” grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. 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 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](tel: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.

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>.