

ENU 4930/6937
Introduction to Nuclear Security and Non-Proliferation
Spring 2017

1. Catalog Description

The course provides engineering students with a brief background and overview of key topics important to nuclear materials safeguards, accountability, non-proliferation and security; it is most useful for engineers who may enter the workforce and are required to handle issues relating to nuclear materials to include homeland security, customs and border security, IAEA, fuel enrichment and fabrication services, nuclear power plants, and related disciplines. This semester, we will focus on the measurement and measurement technologies required for the nuclear security and non-proliferation mission space.

2. Pre-requisites and Co-requisites

Nuclear engineering physics and upper level mathematics background at the graduate or advanced undergraduate level or by instructor permission.

3. Course Objectives

Following successful completion of this course, students will have developed an integrated understanding of the genesis and technical bases from which global (non) proliferation challenges are evolving. Nuclear explosive technology and fission/fusion energy development will be interrelated to nuclear safeguards, 4th generation nuclear systems, (non) proliferation, and national security.

4. Contribution of Course to Meeting the Professional Component (ABET only)

1. Graduates will have successful careers in Nuclear Engineering and related disciplines.
2. Graduates will pursue continuing education or advanced degrees.

5. Instructor

Dr. James E. Baciak
Interim Chair, Materials Science and Engineering
100 Rhines Hall
273-2131
jebaciak@mse.ufl.edu

Office Hours: Monday, Period 2 (8:30 - 9:20 AM)
Wednesday, Period 3 (9:35 – 10: 25 AM)
Friday, Period 8 (3:00 – 3:50 PM)

6. Teaching Assistant

N/A

7. Meeting Times

Periods 4 (10:40 – 11:30 AM)

8. Class Schedule

Three (3) 50-minute lectures each week (Monday, Wednesday, and Friday)

9. Meeting Location

MAEB, Room 238

10. Material and Supply Fees

N/A

11. Textbooks Required

Selected course notes will be provided, as warranted.

Access to Chart of Nuclides:

You will need access to a chart of nuclides during the course. Feel free to use any one of the numerous resources available (so long as it is accurate). Below are a couple of chart of nuclides that I use frequently.

1. Joseph R. Parrington, et al., *Nuclides and Isotopes*, 15th Ed., Lockheed Martin / GE Nuclear, 1996.
2. <http://atom.kaeri.re.kr> (This is a website maintained by the Korea Atomic Energy Research Institute – Recommended)
3. Table of Radioactive Isotopes (TORI) - <http://ie.lbl.gov/toi>

Course Notes

I will place course notes ahead of lectures on Sakai. This will be the location to download other course materials from time to time (e.g., homework, solution sets).

12. Recommended Reading

1. **Nuclear Safeguards, Security, and Nonproliferation**, James E. Doyle: ISBN 978-07506-8673-0.

13. Course Outline

Date	Course Topic
January	4 Introduction, Course Goals and Objectives
	6 The Nuclear Security/Non-Proliferation Mission
	9 The Nuclear Security/Non-Proliferation Mission
	11 The Physics of Fission and Nuclear Reactors
	13 No Class - On Travel (Washington)
	16 No Class – MLK Holiday
	18 Nuclear Fuel Cycle and Enrichment
	20 Nuclear Fuel Enrichment Techniques
	23 Signatures of Special Nuclear Material
	25 Signatures of Spent Nuclear Fuel
	27 No Class – On Travel (University of Illinois)
	30 Radiation Transport Methods
	February
3 No Class – NASA ISI Workshop*	
6 Radiation Transport Methods	
8 No Class – CONTE*	
10 Fundamentals of Radiation Detection – Gamma-Rays	
13 Fundamentals of Radiation Detection – Gamma-Rays	
15 Gamma-Ray Detection and Spectroscopy	
17 Gamma-Ray Detection and Spectroscopy	
20 Fundamentals of Radiation Detection – Neutrons	
22 Fundamentals of Radiation Detection – Neutrons	
24 Neutron Detection in Nuclear Non-Proliferation and Security	
27 Neutron Detection Systems in Nuclear Non-Proliferation and Security	
March	
	3 A Systems-Level View of Nuclear Security
	6 No Class – Spring Break
	8 No Class – Spring Break
	10 No Class – Spring Break
	13 Gamma-Ray and Neutron Imaging
	15 Gamma-Ray and Neutron Imaging
	17 Gamma-Ray and Neutron Imaging
	20 The Nuclear Non-Proliferation Treaty
	22 Overview of Test Ban Treaties
	24 International Convention for the Suppression of Acts of Nuclear Terrorism
	27 UN Security Council Resolutions and International Law
	29 IAEA Safeguards Program and the Convention on Physical Protection of Nuclear Materials
31 Introduction/Overview of Radiochemistry	
April	3 Nuclear Forensics and the Prevention of Illicit Trafficking of Nuclear Material
	5 Nuclear Forensics in a Bottle
	7 Nuclear Material Accountability and Control
	10 No Class – SPIE DSS Conference*
	12 No Class – SPIE DSS Conference*
	14 Student Presentations

- 17 Student Presentations
- 19 Student Presentations (Final Paper Due by 5 PM)

* - Make-up classes may be scheduled, depending on if the class has fallen behind schedule. I also reserve the right to hold make-up classes due to forced cancellations (e.g., hurricanes). Note: there may be 1-2 additional classes cancelled due to required travel (e.g., American Society for Nondestructive Testing). I will announce these in advance along with the makeup dates.

If by chance, we get ahead, I do have plenty of other topics that we can cover, including non-nuclear techniques for the detection of nuclear activities. Based on student interest, we can cover additional materials for this course.

14. Attendance and Expectations

Students are expected to attend each class period. Periods which may be missed should be brought to the attention of the Instructor as far in advance of the class period as possible. In the event of an unexcused absence, it is the student's responsibility to obtain and review the material that was covered during that class period.

15. Grading

Attendance	10%
Homework Sets	20%
Research Paper	50%
Presentation	20%

Homework

From time to time (approximately every couple of weeks), I will provide you with a homework set. Due dates will be indicated on the problem sets I hand out. Be prepared to turn in about 5-6 homework sets throughout the semester. Note: the homework sets will involve both theoretical derivations, analysis of real data, and short papers (1 page or less).

Research Paper

Students will be required to write an individual research paper during the semester. This paper can be on a number of topics; radiation detection R&D, case studies of recent incidents with regards to nuclear security, policy discussion papers, etc. We will discuss possible topics towards the end of September, but feel free to discuss your topic with the instructor at any time. Students will write a final report on their analysis that will be due at 5 PM on **Wednesday, April 19**. Substantial penalties will result from plagiarism and data falsification including automatic course failure and possible expulsion. Grades for the final manuscripts will be based upon technical content and writing style.

Students are asked to follow these guidelines:

- Limit your total number of (total) pages to no more than 20 pages and no fewer than 10 pages (single spaced, 12 point font).
- Each paper shall have a minimum of 5 references.
- Each paper must have at least six tables and figures (any combination).

Presentation

Students will perform a 15-minute, in-class individual presentation on their research paper. This time period will include a 12-minute presentation, with an additional 3 minutes for discussion (very similar to a presentation that would be made at a professional conference).

Grades for the presentation will be based on a number of factors, including: time of presentation, presentation slide quality, interaction with the audience, and participation as an audience member.

16. Make-up Exam Policy

Make-up Exams and Laboratory Experiments are only allowed through prior requests or DOCUMENTED medical reasons. In cases where students will be out of town, a reasonable attempt to take the exam before the scheduled exam date will be performed.

17. Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

18. Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

19. University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student->

[conduct-honor-code/](#)) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

20. Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

21. Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

22. Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus:

https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.