ENU 4930/6937
Introduction to Nuclear Security and Non-Proliferation
Fall 2014

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. Relationship of Course to Program Outcomes (ABET only)

This course supports the following program outcomes:

f. An understanding of professional and ethical responsibility.
h. An understanding of the global, societal and environmental impact of engineering solutions
j. Knowledge of contemporary issues
m. An ability to measure and interpret measurements of nuclear and radiological processes

6. Instructor

Dr. James E. Baciak
Associate Professor
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Office Hours: Tuesday, Period 4 (10:40 – 11:30 AM)
Wednesday, Period 2 (8:30 – 9:20 AM)
Thursday, Period 3 (9:35 – 10:25 AM)

Note: Office hours may change due to other course schedules / upcoming travel schedule

7. Teaching Assistant

N/A

8. Meeting Times

Period 5 (11:45 AM - 12:35 PM)

9. Class Schedule

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

10. Meeting Location

Lecture: 227 NSC (Nuclear Science Building)

11. Material and Supply Fees

None.

12. 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).

13. Recommended Reading

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

14. Course Outline

Date		Course Topic
August	25	Introduction, Course Goals and Objectives
	27	**No Class – DNDO Travel**
	29	The Nuclear Security/Non-Proliferation Mission
September	1	**No Class – Labor Day Holiday**
	3	The Nuclear Security/Non-Proliferation Mission
	5	The Physics of Fission and Nuclear Reactors
	8	Nuclear Fuel Cycle and Enrichment
	10	Nuclear Fuel Enrichment Techniques
	12	Signatures of Special Nuclear Material
	15	Signatures of Spent Nuclear Fuel
	17	Radiation Transport Methods
	19	Radiation Transport Methods
	22	Fundamentals of Radiation Detection – Gamma-Rays
	24	**No Class – On Travel (Ohio State)**
	26	Fundamentals of Radiation Detection – Gamma-Rays
	29	**No Class – AREMA Conference***
October	1	**No Class – AREMA Conference***
	3	Gamma-Ray Detection and Spectroscopy
	6	Gamma-Ray Detection and Spectroscopy
	8	Fundamentals of Radiation Detection – Neutrons
	10	Fundamentals of Radiation Detection – Neutrons
	13	Neutron Detection in Nuclear Non-Proliferation and Security
	15	Neutron Detection Systems in Nuclear Non-Proliferation and Security
	17	**No Class – Homecoming**
	20	A Systems-Level View of Nuclear Security
	22	A Systems-Level View of Nuclear Security
	24	Gamma-Ray and Neutron Imaging
	27	Gamma-Ray and Neutron Imaging
	29	The Nuclear Non-Proliferation Treaty
	31	Overview of Test Ban Treaties
November	3	International Convention for the Suppression of Acts of Nuclear Terrorism
	5	UN Security Council Resolutions and International Law
	7	IAEA Safeguards Program and the Convention on Physical Protection of Nuclear Materials
	10	**No Class – ANS Conference***
	12	**No Class – ANS/IEEE Conferences***
	14	**No Class – IEEE Conference***
	17	Introduction/Overview of Radiochemistry
	19	Nuclear Forensics and the Prevention of Illicit Trafficking of Nuclear Material
	21	Nuclear Forensics in a Bottle
	24	Nuclear Material Accountability and Control
	26	**No Class - Thanksgiving Holiday**
	28	**No Class - Thanksgiving Holiday**
December	1	Student Presentations
	3	Student Presentations

5 Student Presentations
8 Student Presentations
10 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.

15. 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.

16. Grading

Your overall grade is based on your performance in both the lecture and laboratory, with each weighted equally. Note: you MUST receive a passing grade in both parts of the course in order to receive a passing grade (e.g., an A in lecture and an E in lab does not equal a C; it will be recorded as an E!). Below is a breakdown for the grading in the lecture and laboratory:

Lecture Grading

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

Lecture Grading

Homework

From time to time (approximately every couple of weeks), I will provide you with a number of homework problems. 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 you 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, December 10**. 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.

17. Grading Scale

The grading scale is generally as follows:

94-100	A
90-93	A-
87-89	B+
84-86	B
80-83	B-
77-79	C+
74-76	C
70-63	C-
67-69	D+
64-66	D
60-63	D-
0-59	E

Since I do not curve the grading scale, all students can receive an A (or an E)! Note: this scale may be adjusted from semester-to-semester by a couple of points depending on topics covered and difficulty of exams.

18. Make-up Exam Policy

Make-up Exams 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.

19. Honesty Policy

All students admitted to the University of Florida have signed a statement of academic honesty, committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

20. Accommodation for Students with Disabilities

Students requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. UF Counseling Services

Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

- University Counseling Center, 301 Peabody Hall, 392-1575, Personal and Career Counseling.
- SHCC mental Health, Student Health Care Center, 392-1171, Personal and Counseling.
- Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161, sexual assault counseling.
- Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.

22. Software Use

All faculty, staff and student 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.