ENU 4641C
Applied Radiation Protection
Spring 2018

1. Catalog Description

Introduction to practical radiation protection techniques and practices. Fundamental introduction to concepts and risks associated with exposure to radiation. Examination of pertinent regulations, current practice, ethics, and instrumentation / measurement practices. Introduction to design aspects of radiation protection.

2. Pre-requisites and Co-requisites

Prerequisites for ENU 4505L:

ENU 4605	Interaction of Radiation with Matter
ENU 4630	Fundamentals of Radiation Shielding

3. Course Objectives

This course is designed to introduce nuclear engineering and nuclear engineering sciences students to the basic principles, concepts, and methodology of radiation protection and radiological hazard evaluation, including the regulatory environment in which nuclear scientists and engineers operate.

4. Contribution of Course to Meeting the Professional Component

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

This course supports the following program outcomes:

e. An ability to identify, formulate, and solve engineering problems
f. An understanding of professional and ethical responsibility
g. An ability to communicate effectively
i. A recognition of the need for and an ability to engage in life-long learning
j. A knowledge of contemporary issues as they relate to professional engineering practice
l. An ability to apply advanced mathematics, science, and engineering sciences, including atomic and nuclear physics, to nuclear and radiological systems and processes
n. An ability to work professionally in one or more of the areas of: nuclear power systems, nuclear instrumentation and measurement, radiation protection and shielding, and radiation sources and applications

6. Instructor

Dr. Sasmit S. Gokhale
Adjunct Lecturer
Office: 109 Nuclear Science Building
Ph.: (352) 871-9034
Email: sasmitg@ufl.edu

Office Hours: Monday, Wednesday, and Friday, Period 4 (10:40 – 11:30 AM)

You are always more than welcome to schedule an appointment to see me outside of scheduled office hours.

7. Teaching Assistant

NA

8. Meeting Times

Period 5 (11:45 AM – 12:35 PM) on Monday, Wednesday, and Friday

9. Class Schedule

Three class periods each week (Monday, Wednesday, and Friday).

10. Meeting Location

MAEB 234

11. Material and Supply Fees

N/A

12. Textbooks Required

Richard E. Faw and J. Kenneth Shultis
Radiological Assessment: Sources and Exposures
American Nuclear Society (1999)
ISBN 0-89448-455-9 (You can order the book through ANS at www.ans.org/store)

I will also provide various handouts from NCRP, ICRP, and ICRU Reports

13. Recommended Texts

1. Glenn F. Knoll, *Radiation Measurement and Detection*, 4th Ed., Wiley and Sons, 2010.

2. Herman Cember and Thomas Johnson, *Introduction to Health Physics,* 4th Ed., McGraw Hill, 2008

Recommended Texts and Support to Assist with Term Paper Writing

1. The Mayfield Handbook of Technical and Scientific Writing (available at http://www.mhhe.com/mayfieldpub/tsw/toc.htm). *Excellent resource and free!*
2. Writing standards for a variety of Nuclear and Radiological Engineering related journal publications, including Nuclear Instruments and Methods, IEEE Transactions on Nuclear Science, Nuclear Technology, and Journal of Health Physics. These are available on the web, but I can provide you with copies by request).
3. The University of Florida Reading and Writing Center is also available to help students become better readers and writers. More information (including operating hours) can be found at http://www.at.ufl.edu/rwcenter.

Course Notes

I will place course notes ahead of lectures on Canvas. The notes I post may only contain fragments of the entire lecture, students are required to attend class and fill in the blanks as necessary, according to written lecture notes dictated in class. Canvas will also be the location to download other posted course materials, such as homework, solution sets, and sample problems.

14. Tentative Course Outline

Date		Lecture Topic	Book Chapter
January	8	Introduction/Course Overview	
	10	Biological Effects of Radiation	3
	12	Biological Effects of Radiation	3
	15	**No Class – MLK Holiday**	
	17	**No Class**	
	19	Biological Effects of Radiation	3
	22	Cancer Facts and Figures	Handouts
	24	BEIR VII Risk Models	Handouts
	26	BEIR VII Risk Models	Handouts
	29	BEIR VII Risk Models	Handouts
	31	Exposure to Natural Sources of Radiation	4
February	2	Exposure to Natural Sources of Radiation	4
	5	Exposure to Man-Made Sources of Radiation	5
	7	Exposure to Man-Made Sources of Radiation	5
	9	External Dose Assessment – Gamma-Rays	6
	12	External Dose Assessment – Neutrons	6
	14	Electron Dose Evaluation	7
	16	Electron Dose Evaluation	7
	19	Internal Dose Assessment	8
	21	Internal Dose Assessment	8
	23	Internal Dose Assessment	8
	26	Internal Dose Assessment	8
	28	Atmospheric Dispersion of Radionuclides	9

March	2	Atmospheric Dispersion of Radionuclides	9
	5	**No Class – Spring Break**	
	7	**No Class – Spring Break**	
	9	**No Class – Spring Break**	
	12	Atmospheric Dispersion of Radionuclides	9
	14	Dispersion of Radionuclides in Surface/Ground Water	10
	16	Dispersion of Radionuclides in Surface/Ground Water	10
	19	Dispersion of Radionuclides in Surface/Ground Water	10
	21	Environmental Pathway Modeling	11
	23	Environmental Pathway Modeling	11
	26	**No Class – Work on Review Paper**	
	28	**No Class – Work on Review Paper**	
	30	**No Class – Work on Review Paper**	
April	**2**	**Student Presentations**	
	4	**Student Presentations**	
	6	**Student Presentations**	
	9	**Student Presentations**	
	11	**Final Term Papers Due (by 5 PM)**	
	13	**Final Exam (12:30 – 2:30 PM)**	

Note: Course material and schedule may change due to additional travel I may encounter. I will give advanced warning if this is to be the case. Additional make up classes may be scheduled during the class periods at the end of March, currently marked "Work on Review Paper."

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

Attendance	10%
Homework Sets	20%
Quizzes	10%
Midterm Exam (Take Home)	15%
Presentation	10%
Final Paper	20%
Final Exam	15%

Homework Sets

There will be about 4-5 homework sets during the course. Homework sets will be due one week after the assignment (unless specified otherwise).

Quizzes

There will be two scheduled in-class quizzes during the course. I will give a one-lecture advanced warning for these quizzes. I may randomly give out pop quizzes during the lecture periods. These will consist of one or two relatively short/simple questions in order to assess how well students have been paying attention to class concepts. They will also make up the attendance portion of the grade in order to ensure students attend every lecture, unless an appropriate excuse is given prior to missing a class.

Midterm and Final Exam

There will be a take-home midterm examination that I will hand out sometime in Late February. This will be more like an extended homework assignment, with a number of the problems that will need to be solved.

A cumulative 2-hour final exam is currently officially scheduled for **Wednesday, May 2nd, 2018** from 10:00 AM – 12:00 PM.

The exams will be open book and will test your knowledge you should have acquired during course (as well as materials from the prerequisite courses). Expect the exams to consist of multiple choice, diagram drawings, basic calculations, and short answer questions.

Presentation

Students will perform a 15-minute, in-class team 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.

Term Paper

Pairs of students will be required to write research paper during the semester. This paper can be on a number of topics within the realm of radiation protection. We will discuss possible topics towards the end of January, but feel free to discuss your topic with the instructor at any time. Students will write a final report that will be due at 5 PM on **Wednesday, April 11th, 2018**. Substantial penalties will result from plagiarism and data falsification including automatic course failure and possible expulsion. Grades for the final manuscripts will also 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), excluding figures and tables.
- Each paper shall have a minimum of 5 references from peer-reviewed journal publications.
- Each paper must have at least six tables and figures (any combination). These can be generated by you, or from your references.

Details for Final Report Writing

1) Your **audience** is a nuclear engineer, knowledgeable but possibly unfamiliar with your primary topic
2) Figures (Drawings and Plots)
    a) Your goal is to make your reports as understandable as possible. Therefore, use figures liberally.
    b) Do not turn in a report with pencil drawings on it. No hand-drawings for figures will be accepted.
    c) When making plots, use a software package such as MS Excel, SigmaPlot, or the like. Include axes labels (with units) and label each of the figures in your report.
3) Formal writing (textbook style).
    a) Do not use a conversational tone (i.e. write in complete sentences, do a spell check)
    b) Do not write in the first person.
    c) Font size: 10 - 12
4) An Appendix is supplemental to the report. If you included an appendix, do not expect it to be read. If you want the reader to see something, then put it in the body of the report.

Successful Completion of Gordon Rule Writing Requirements

You receive 2,000-word credit for this course. I will evaluate your writing on a number of criteria: Content, Organization, Argument and Support, Style, and Mechanics. In order to be a successful writer (and therefore receive a Satisfactory evaluation for your writing/communication requirements), please look over the following guidelines on satisfactory completion of Gordon Rule Writing requirements for this course.

	SATISFACTORY (Y)	UNSATISFACTORY (N)
CONTENT	Papers exhibit at least some evidence of ideas that respond to the experiment/laboratory topic with complexity, critically evaluation the results, and provide at least an adequate discussion with basic understanding of experiment.	Papers either include a central discussion that is unclear or off- topic or provide only minimal or inadequate discussion of the experimental results. Papers may also lack sufficient or appropriate discussion of the results, with little or no tie-in with the underlying theory.
ORGANIZATION AND COHERENCE	Documents and paragraphs exhibit at least some identifiable structure for topics, including a clear thesis statement but may require readers to work to follow progression of ideas. Figures, tables and graphs are used in a logical manner to properly explain results, with these items being placed within a logical manner/progression of the experimental result. An outside nuclear engineer should be able to understand your report, and be able to repeat at least some of the experiment.	Documents and paragraphs lack clearly identifiable organization, may lack any coherent sense of logic in associating and organizing ideas, and may also lack transitions and coherence to guide the reader. Poor use of figures, graphs, and tables do not provide any cohesion with the discussion in the report.
ARGUMENT AND SUPPORT	The reports use persuasive and confident presentation of ideas, strongly supported with experimental evidence (including comparisons with what your theoretical expectations). At the weak end of the Satisfactory range, documents may provide only generalized discussion of the experimental results or may provide adequate discussion but rely on weak support for arguments.	Documents make only weak generalizations, providing little or no support, as in summaries or narratives that fail to provide critical analysis. No crucial comparisons with the underlying theory of the experimental results.
STYLE	Documents use a writing style with word choice appropriate to the context, genre, and discipline. Sentences should display complexity and logical sentence structure. At a minimum, documents will display a less precise use of vocabulary and an uneven use of sentence structure or a writing style that occasionally veers away from word choice or appropriate tone. Figures, tables and graphs follow an	Documents rely on word usage that is inappropriate for the context, genre, or discipline. Sentences may be overly long or short with awkward construction. Documents may also use words incorrectly. Figures, tables and graphs are poorly constructed with little adhesion to a consistent format.

	appropriate style/format, and that style is used consistently throughout the document. For additional information on style and format, I will provide you with sample reports. In addition, you can consult the writing formats for a variety of publications, including Journal of Health Physics, Nuclear Instruments and Methods in Physics Research, or IEEE Transactions on Nuclear Science.	
MECHANICS	Reports will feature correct or error-free presentation of ideas. At the weak end of the Satisfactory range, reports may contain some spelling, punctuation, or grammatical errors that remain unobtrusive so they do not muddy the paper's argument or points.	Papers contain so many mechanical or grammatical errors that they impede the reader's understanding or severely undermine the writer's credibility.

The student must earn an S (satisfactory) evaluation on the writing requirements of the course. To help you in understanding how your reports are graded, review the rubric below. All reports are graded out of 100 points. Note that I consider both technical and grammatical correctness in determination of your grade.

You will be provided a grading rubric for the paper (and a separate one for the presentation) once paper topics have been determined.)

17. Grading Scale

The grading scale is generally as follows:

93-100	A	73-76	C
90-92	A-	70-72	C-
87-89	B+	67-69	D+
83-86	B	63-66	D
80-82	B-	60-62	D-
77-79	C+	0-59	E

Since I do not curve the grading scale, all students can receive an A (or an E)! Note: this scale can be adjusted from semester-to-semester by a couple of points depending on specific topics covered and difficulty. Also, students within a point of two grades may be rounded up to the better letter grade if participation and attendance are good. Otherwise, traditional rounding to the tenth decimal place will decide final letter grade for students in between two grades.

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 and Wellness 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.