Fundamental Aspects of Radiation Shielding

ENU 4630

Class Periods: Monday, Periods 4 and 5, 10:40 a.m. – 12:35 p.m.
Wednesday, Period 4, 10:40 a.m. – 11:30 a.m.
Location: Online. Access information will be provided via Canvas.

Academic Term: Fall 2020

Format: This course will be conducted via an online delivery format. The lectures will be presented via Zoom and will be conducted at the same time as the normally scheduled meeting hours for the class.

Instructor:
Dr. Donald Wall
Donald.wall@ufl.edu
Phone: 352-273-2662
Office Hours: There will not be any in-person meetings as a part of office hours. I will be available for Zoom meetings during the following times:

Wednesday 1:00 p.m. – 4:00 p.m.
Thursday, 10:00 a.m. – 1:00 p.m.
Additional times are available by appointment.

I will post links to Zoom office hours on Canvas.

Teaching Assistants:

- none

Course Description
Three one-hour lectures discussing basic principles of radiation shielding. The course material will include study of radiation sources and shielding design of radiation facilities.

Course Pre-Requisites / Co-Requisites
ENU 4605 with a minimum grade of C.

Course Objectives
The course objectives include comprehension and proficiency in the following topics:

- Determining the shielding requirements that are necessary to provide protection against radiation
- Using the knowledge of the characteristics of shielding materials to determine appropriate shielding design
- Incorporating calculations into the shielding design process to determine an optimum shielding model that provides an appropriate protection for workers, the environment and the public

The course objectives will be addressed by means of:

- textbook study
- lecture material that will compliment and clarify the textbook material
- provide examples of applications, including some in-class problem solving exercises
- assigned problems, with emphasis on problems that have applications in the field

Materials and Supply Fees
none

Professional Component (ABET):
3 credits of engineering topics.

Relation to Program Outcomes (ABET):

Outcome	**Coverage***
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	High
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Medium
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

Required Textbooks and Software

- Radiation Shielding (2000)
- J. Kenneth Shultis, Richard E. Faw
- American Nuclear Society, ISBN: 0-89448-456-7
- 978-3-527-40606-7

Students must have the most recent version of the MCNP6.2 code. The instructor will explain how to obtain a copy.

Recommended Materials

- Nuclides and Isotopes, Chart of the Nuclides
  Published by Knolls Atomic Power Laboratory
  Publication date: 2010, 17th Edition
  Available at www.nuclidechart.com

Note that the current price for a chart directly from Bechtel/KAPL is $30, which is lower than the prices that are found at some other vendors. The book is the preferable format for classroom use. An earlier Edition is also acceptable.

Course Schedule

Class meeting times:
Monday 10:40 a.m. – 12:35 p.m.
Wednesday 10:40 a.m. – 11:30 a.m.

Final exam:
December 18, 2020
7:30 a.m. – 9:30 a.m.
Location TBA

Date	Subject	Reading	Comments
Week 1 (Aug 31 & Sept 2)	Course introduction, concepts, acronyms, nomenclature, units	Ch. 2, Chart of Nuclides, National Nuclear Data Center	
Week 2 (Sept 7 & 9) Sept 7, Labor Day No classes.	neutron, photon, charged particle interactions and radiation sources	Ch. 2, 3 Chart of Nuclides, National Nuclear Data Center,	A1 due Sept 9 Q1 Sept. 9
Week 3 (Sept 14 & 16)	neutron, photon, charged particle interactions and radiation sources	Ch. 3, 4	A2 due Sept. 16 Q2 Sept. 16 (Subject Ch. 3)
Week 4 (Sept 21 & 23)	Sources of radioactivity and shielding criteria, response functions, dosimetry	Ch. 4, 5	Q3 Sept. 23 (Subject: Ch. 4)
Week 5 (Sept 28 & 30)	response functions and dosimetry	Ch. 5	Exam 1 Sept. 30 (Subject: Weeks 1 – 4)

Week 6 (Oct 5 & 7)	MCNP for shielding applications	handouts	
Week 7 (Oct 12 & 14)	MCNP for shielding applications	handouts	A3 due Oct 14
Week 8 (Oct 19 & 21)	radiation transport, dose calculations	Ch. 6	
Week 9 (Oct 26 & 28)	***Team project updates*** radiation transport, dose calculations	Ch. 6	A4 Due Oct 28
Week 10 (Nov 2 & 4)	photons	Ch. 7	Q4 Nov. 2 (Subject: Ch 6)
Week 11 (Nov 9 & 11)	photons (Nov 9) no class on Nov 11 (Veterans' Day)	Ch. 7	Exam 2 Nov. 9 (Subject: Weeks 5 – 10)
Week 12 (Nov 16 & 18)	Photons, Neutrons	Ch. 7, 8	Quiz 5 Nov. 16 (Subject: Ch. 7)
Week 13 (Nov. 23) Nov 25, Thanksgiving Holiday, No class	Neutrons	Ch. 8	A5 due Nov 23
Week 14 (Nov 30 & Dec 2)	Presentations Project Report due on Nov. 30		
Week 15 (Dec 7 & 9)	Charged particles	Ch. 9	
Week 16 Dec. 18	Final exam		

Note: A# refers to Assignment *number.* Q# refers to Quiz *number*.
Supplemental course material, i.e. handouts/notes will be distributed in electronic format—usually as .pdf files.

Attendance Policy, Class Expectations, and Make-Up Policy

This course will be delivered in an online format. Contact me immediately if you are experiencing difficulties in this course.

The following statement has been promulgated by the College of Engineering:

Online Course Recording
Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy. This class will be presented in an online format, which will require that students join via Zoom. The Zoom invitation will be posted on Canvas. Credit and grades will not be apportioned or removed for attendance. I strongly recommend attending. Class sessions *may be recorded and posted*, but there is no guarantee that all of the class sessions will be recorded and posted.

Makeup Exam Policy. Students who need to miss an exam due to extenuating circumstances and who wish to take a makeup exam will be required to provide prior notice and to provide evidence that it is necessary to miss the exam. Missing an exam without prior notice will only be excused under documented and compelling circumstances. Makeup exams will not be permitted if the instructor is not notified of the circumstances within 48 hours after the exam has been given. A makeup exam shall be scheduled in accordance with University policy.

Quizzes. The quizzes will generally be brief and may be at either the beginning or end of the class period according to the circumstances; the subject matter will be announced on the class period preceding the quiz date. Makeup quizzes will only be given under documented circumstances according to the University policy.

Assignments. Assignments must be submitted via Canvas, *not sent to me as email attachments*. Assignments that are late will receive a penalty of 10% per day for the first two days. Assignments will not be accepted any later than 48 hours following the due time and date.

Excused absences must be consistent with university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation.

Legibility. *Assignments or portions of assignments, (including quizzes and exams) that are illegible will receive zero credit.* As a guideline, difficult to read (or messy) = illegible.

Evaluation of Grades

Assignment	Total Points
Assignments (5)	100
Quizzes (5)	100
Exam 1	100
Exam 2	100
Project report	100
Project presentation	100
Final Exam	100
	700

Grading Policy

Percent	Grade	Grade Points
94 - 100	A	4.00
90 - 93	A-	3.67
86 - 89	B+	3.33
83 - 85	B	3.00
80 - 83	B-	2.67
76 - 79	C+	2.33
73 - 75	C	2.00
70 - 72	C-	1.67
66 - 69	D+	1.33
63 - 65	D	1.00
60 – 62	D-	0.67
< 60	E	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

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.

Commitment to a Safe and Inclusive Learning Environment
The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
• Your academic advisor or Graduate Program Coordinator
• Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
• Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
• Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

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.

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: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

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 Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

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 suppor*t*, 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.