Radiation Interactions and Sources 1

ENU 4605

Class Periods: Monday and Wednesday, Periods 2 and 3, 8:30-10:25 am

Location: TBD

Academic Term: Fall 2020

Instructor:
Yong Yang
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Phone: 352-846-4791
Office Hours: Tuesday (1:30-4:30pm) through Zoom.
Additional times are available by appointment

Teaching Assistants:

- none

Course Description

Study of the interaction of ionizing radiations with matter; cross-sections and radiation fields with emphasis on neutrons and photons (gamma-rays and X-rays); attenuation, energy transfer and energy absorption

Course Pre-Requisites / Co-Requisites

The UF course catalog does not list prerequisites or co-requisites for this course

Course Objectives

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

- atomic and nuclear structures, nuclear reaction, and radioactive decay
- Characteristics of types of radiation
- Interactions between radiations with matters, and characterizations of radiation fields
- Solving problems that are representative of issues found at the workplace such as safe handling of radioactive materials

The course objectives will be addressed by means of:

- Textbook study
- Lecture materials that will compliment and clarify the textbook material
- Provide examples of applications, including some in-class problem solving exercise
- Homework and exam problems

Materials and Supply Fees

- none

Professional Component (ABET):

4 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	Medium
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	Low
3. an ability to communicate effectively with a range of audiences	
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	Low
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.	

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software

Atoms, Radiation and Radiation Protection
James E. Turner
2007, 3rd Edition
ISBN 978-3-527-40606-7
Referred as (**T**) in Syllabus

References:

1. Fundamentals of Nuclear Science and Engineering,
J. Kenneth Shultis and Richard E. Faw
Marcel Dekker, InC. New York,
ISBN 0-8247-0834-2, 2002
Referred as (**S&F**) in Syllabus

2. Introduction to Radiological Physics and Radiation Dosimetry
Frank H. Attix
Wiley & Sons, Inlc. 1986
Referred as (**A**) in Syllabus

3. Physics for Radiation Protection
James E. Martin
John Wiley & Sons Inc. 2000
Referred as (**M**) in Syllabus

4. Nuclear Reactor Physics, Chapters 1 and 2
Weston M. Stacey
John Wiley @ Sons, 2001
Referred as (**S**) in Syllabus

5. Nuclides chart: http://atom.kaeri.re.kr/

6. Java-based Nuclear Data Information System (Janis): https://www.oecd-nea.org/janis/

Course Schedule

Module	Class	Date	Subject	Reading	Assignments
1. Introduction: Basic Concepts and Quantities	1	Aug 31	Course introduction, concepts, acronyms, nomenclature, units.	(T) Chapter 1-2 (A) Chapter 1 (M) Chapter 1, and parts of chapters 2 and 3 (S&F) Chapter 1 and sections 2.1 through 2.3 and 3.1	
	2	Sep 2	Fundamentals of atomic structure, atomic radiation		HW 1
		Sep 7	Labor Day. No class		
	3	Sep 9	Classification or types of radiation, ionizing versus non-ionizing radiation, X-rays, concepts of flux and fluence		
2. Nuclear Physics and Nuclear Radiation	4	Sep 14	Nuclear structure, nuclides chart	(T) Chapter 3 (A) Chapter 5 (M) Parts of chapters 2, 3 and 5 (S&F) Chap 4 and sections 3.2 and 5.1 through 5.3 Nuclides chart	
	5	Sep 16	Binding energy		
	6	Sep 21	Q-equation		HW 2
	7	Sep 23	α, β, and γ radiations		
3. Radioactive decay	8	Sep 28	Radioactive decay modes, energies, review on modules 1 and 2	(T) Chapter 4 (A) Chapter 6 (M) Chapters 5 and 6 (S&F) Sections 5.4 through 5.7 Chapter 9	
	9	Sep 30	Exam 1		Exam 1 (module 1-2)
	10	Oct 5	Decay dynamics, activity		
	11	Oct 7	Radioisotope production, Natural radioactivity		HW 3
4. Characterization of radiation fields	12	Oct 12	Cross sections	(A) Chapter 2 and 3 (M) Parts of chapters 7 and 8 (S&F) sections 7.1 through 7.2 and 9.1 through 9.3	
	13	Oct 14	Interaction rates, flux, current		
	14	Oct 19	Angular (differential) distributions		HW4
	15	Oct 21	Activity, dose, exposure		
	16	Oct 26	Exponential attenuation, Buildup factors		

5. Neutron Interactions	17	Oct 28	Nuclear reactions, review of modules 3 and 4.	(S) Chapters 1 and 2 (T) Chapter 9 (A) Chapter 16 (M) Parts of chapters 4 and 14 (S&F) Chap 6 and Sections 7.4 and 10.1 through 10.3	
	18	Nov 2	Exam 2		Exam 2 (module 3-4)
	19	Nov 4	Compound nucleus, Kinetics of neutron scattering		
	20	Nov 9	Thermally averaged cross sections		HW5
		Nov 11	Veterans Day. No class		
	21	Nov 16	Fission and Resonance behavior		
6. Photon Interactions	22	Nov 18	Compton effect, photoelectric effect,	(T) Chapter 8 (A) Chapter 7 (M) Parts of chapters 4 and 7 (S&F) Section 7.3	
	23	Nov 23	Pair production, Rayleigh scattering		HW 6
		Nov 25-28	Thanksgiving Break. No class		
	24	Nov 30	Photonuclear interactions		
	25	Dec 2	Energy transfer, Energy absorption		
	26	Dec 7	Course reviewing and problem solving		
		Dec 12	Final exam (cumulative)		

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, Class Expectations, and Make-Up Policy

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.

Makeup Quiz and Exam Policy. Students who need to miss a quiz or exam due to extenuating circumstances and who wish to take a makeup quiz or exam will be required to provide prior notice and to provide evidence that it is necessary to miss the quiz or exam. Missing a quiz or exam without prior notice will only be excused under documented and compelling circumstances. Makeup quizzes or exams will not be permitted if the instructor is not notified of the circumstances within 48 hours after the exam has been given. Makeup quizzes or exams will only be given under the direct supervision of the instructor and *will not* be the same as the original quiz or exam. A makeup quiz or exam shall be scheduled within 72 hours of the original quiz or exam time, unless there are documented and compelling circumstances and in accordance with University policy.

Electronic Devices. Use of electronic devices for any reason other than immediate course-related purposes is prohibited. This includes cell-phone use, texting, checking email, internet use and similar activities. Laptops may be used to take notes or for specific course-related purposes as authorized by the instructor. Laptops may not be used for other purposes such as checking email or internet use. A person who commits an

infraction will be required to leave the classroom for the remainder of the day. Repeated infractions will be subject to sanctions as stated in University policies regarding student conduct.

Late homework. Homework is due at 5 pm two weeks after the assignment. Homework that is late will receive a penalty of 10% per day for the first two calendar days (i.e. 48 hours from the time and date it was due) after the due date. Homework will not be accepted any later than 48 hours following the due time and date. Homework *must* be submitted either directly to the instructor or according to specific instructions. *Do not leave homework or other assignments in the instructor's mailbox, at any other place or with any other person unless specifically told to do so.* Note that the Materials Engineering building is locked late in the day and will be inaccessible after hours.

Legibility. The fact is that legibility is generally a non-negotiable requirement in the workplace. Assignments or portions of assignments, (i.e. quizzes, homework *and* exams) that are illegible will receive zero credit. It is true that some people have poor handwriting. If that is the case, write slower, find a way to improve legibility and consult with the instructor for possible solutions. Please provide a sample of your writing to get an opinion if you are not sure whether it is legible. As a guideline, difficult to read (or messy) = illegible. *Assignments that are illegible will receive zero credit.*

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework sets (6)	25%
Exam 1	20%
Exam 2	25%
Final exam	30%
Total	100%

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 - 82	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 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.

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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-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.