

Radiation Interactions and Sources 1
ENU 4605, Class 12931, Section 1747, Fall 2021
MW 0830-1025 (UF Periods 2 and 3)
M WEIM 1070
W WEIM 2056
Final Exam 12/17/2021 1000-1200 in WEIM 1070

Instructor

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Office Hours: M 1300-1400, T 1000-1100, W 1300-1400, R 1000-1100, and by appointment. Beginning and end times of office hours will be enforced strictly. Zoom meeting links will be provided for office hours. If I do not respond on Zoom or if Zoom is not logged in, please send me an email or message in Microsoft Teams and I will respond as soon as possible.

Course Description

Three one-hour lectures discussing interaction of ionizing radiation with matter; cross sections and radiation fields with emphasis on photons, heavy charged particles, and electrons.

Course Prerequisites

None

Course Objectives

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

- Atomic and nuclear structures, nuclear reactions, and radioactive decay
- Characteristics of different types of radiation
- Interactions between radiation and matter and characterization of radiation fields
- Solving problems that are representative of issues found at workplaces

Professional Component (ABET)

4 credits of engineering topics

Relation to Program Outcomes (ABET)

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (medium coverage)
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 coverage)

3. n/a
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 coverage)
5. n/a
6. n/a
7. n/a

Text

Atoms, Radiation and Radiation Protection
James E. Turner
2007, 3rd edition
ISBN 978-3-527-40606-7
Referred to as (T) in course materials

References

Nuclides and Isotopes (Chart of the Nuclides)
Bechtel Marine Propulsion Corporation
Seventeenth Edition (2010)
Available at: <https://www.nuclidechart.com/>
Note: Get the “Book with Embedded Chart” product.

Fundamentals of Nuclear Engineering
J. Kenneth Shultis and Richard E. Faw
Marcel Dekker, Inc. New York, 2016
ISBN 978-1-498-76929-7
Referred to as (S&F) in course materials

Introduction to Radiological Physics and Radiation Dosimetry
Frank H. Attix
Wiley & Sons, 1986
ISBN 978-0-471-01146-0
Referred to as (A) in course materials

Physics for Radiation Protection
James E. Martin
Wiley & Sons, 2000
ISBN 978-3-527-41176-4
Referred to as (M) in course materials

Nuclear Reactor Physics
Weston M. Stacey
Wiley & Sons, 2018
ISBN: 978-3-527-81230-1

Referred to as (S) in course materials

Lecture Schedule

Module Legend

- 1: Introduction
- 2: Nuclear Physics
- 3: Radioactive Decay
- 4: Photon Interactions
- 5: Charged Particle Interactions
- 6: Neutron Interactions
- 7: Characterization of Radiation

Date	Module	Due	(Lecture #) Topic	Reading
Aug 23	1		(1) Introduction to course	(T) Ch. 1
Aug 25	1		(2) Atomic structure & atomic radiation	(T) Ch. 2
Aug 30	1		(3) Types of radiation, flux and fluence	(T) Ch. 2
Sep 1	2	HW 1	(4) Nuclear structure, chart of Nuclides	(T) Ch. 3
Sep 6			Labor Day (No Class)	
Sep 8	2		(5) Binding energy	(T) Ch. 3
Sep 13	2		(6) Nuclear equations (Q-values)	(T) Ch. 3
Sep 15	2		(7) α , β , and γ radiation	(T) Ch. 3
Sep 20	3	HW 2	(8) Activity	(T) Ch. 4
Sep 22	3		(9) Radioactive series decay	(T) Ch. 4
Sep 27	3		(10) Equilibrium	(T) Ch. 4
Sep 29	3		(11) Photoelectric effect	(T) Ch. 4
Oct 4	4	HW 3	(12) Compton scattering	(T) Ch. 8
Oct 6	4		Exam 1 Review	(T) Ch. 8
Oct 11			Exam 1 (Modules 1-3)	
Oct 13	4		(13) Pair production, photonuclear interactions	(T) Ch. 8
Oct 18	4		(14) Attenuation, energy transfer, energy absorption	(T) Ch. 8
Oct 20	5	HW 4	(15) Heavy charged particles	(T) Ch. 5
Oct 25	5		(16) Heavy charged particles	(T) Ch. 5
Oct 27	5		(17) Electron interactions	(T) Ch. 6
Nov 1	5		(18) Charged particle track phenomena	(T) Ch. 7

Date	Module	Due	Subject	Reading
Nov 3	6	HW 5	(19) Neutron sources & classifications	(T) Ch. 9
Nov 8	6		(20) Neutron interactions	(T) Ch. 9
Nov 10	6		Exam 2 Review	
Nov 15	6		Exam 2 (Modules 4-6)	
Nov 17			(21) Fission	(T) Ch. 9
Nov 22			(22) Criticality	(T) Ch. 9
Nov 24			Thanksgiving (No Class)	
Nov 29	7	HW 6	(23) Interaction coefficient and cross sections	(T) Ch. 9
Dec 1	7		(24) Dosimetric quantities, absorbed dose, KERMA	(T) Ch. 12
Dec 6	7		(25) Exponential attenuation, buildup factors	
Dec 8		HW 7	Final Exam Review	
Dec 17			Final Exam (10:00 am to 12:00 pm)	

Module Reference Guide

Module 1

- (T) Ch. 1 and Ch. 2
- (A) Ch. 1
- (M) Ch. 1 and parts of Ch. 2 and Ch. 3
- (S&F) Ch. 1 and Sections 2.1 through 2.3 and 3.1

Module 2

- (T) Ch. 3
- (A) Ch. 5
- (M) Parts of Ch. 2, 3, and 4
- (S&F) Ch. 4, Section 3.2, Sections 5.1 through 5.3
- Chart of the nuclides

Module 3

- (T) Ch. 4
- (A) Ch. 6
- (M) Ch. 5 and Ch. 6
- (S&F) Sections 5.4 through 5.7 and Ch. 9

Module 4

- (T) N/A
- (A) Ch. 2 and Ch. 3
- (M) Parts of Ch. 7 and Ch. 8
- (S&F) Sections 7.1 and 7.2 and Sections 9.1 through 9.3

Module 5

- (T) Ch. 8
- (A) Ch. 7
- (M) Parts of Ch. 4 and Ch. 7
- (S&F) Section 7.3

Module 6

- (T) Ch. 5, 6, and 7

Module 7

- (T) Ch. 9
- (S) Ch. 1 and Ch. 2
- (A) Ch. 16
- (M) Parts of Ch.4 and Ch. 14
- (S&F) Ch. 6 and Sections 7.4 and 10.1 through 10.3

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.

The statement above is required by UF policy and inserted on the chance classes are offered with online or HyFlex modalities.

Grading

Assessments in this course are worth a total of 1000 points broken down as follows:

- (7) Homework Assignments – 300 points (50 each; lowest HW grade will be dropped)
- (2) During Term Exams – 400 points (200 each)
- (1) Final Exam – 300 points

Grades will be assigned based on the following scale:

- A: 870+ points
- A-: 850-869 points
- B+: 830-849 points
- B: 750-829 points
- C: 660 - 749 points
- E: < 660 points

More information on the UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Course Policies

Attendance

Attendance is strongly recommended starting on the first day of class. However, attendance is not part of grade calculations.

Pursuant to HWCOE policy, the following statement is required: Excused absences are consistent with university policies in the undergraduate catalog. <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx> and require appropriate documentation.

Class Conduct

There is no tolerance for mobile phones or other electronic disruptions. Changing your Zoom settings to mute yourself upon joining a meeting is strongly recommended.

Assignments

Assignments must be submitted electronically (via Canvas). The following restrictions apply for submission:

- All submissions must be a single PDF document.
- If you do not have access to a physical scanner and you choose to use a phone or tablet to “scan” your handwritten document, you must use the free Adobe Scan app.
- Fully electronic alternatives include a PDF from Word with Equation Editor or L^AT_EX.

The following penalties apply for late assignments:

- Late assignments submitted up to 24 hours after the due date will have 25% of the maximum possible points subtracted, except for excused absences as defined by university policy.
- Late assignments submitted more than 24 hours after the due date will receive no credit, except for excused absences as defined by university policy.

Electronic Communication and Course Website

Canvas is used extensively for the course including, but not limited to:

- Distributing and storing the course syllabus, along with any syllabus updates
- Maintaining student grades
- Regular communication with students through announcements
- Providing access to course materials
- Accessing scheduled Zoom meetings

Microsoft Teams is used extensively for this course including, but not limited to:

- Regular communication with students through announcements and messages
- Communication between students and instructor through the “Chat” feature.

Zoom is used extensively for this course including, but not limited to:

- Lectures during the scheduled period
- Regularly scheduled office hours
- Special office hours by appointment

Changes to Syllabus

Changes to this syllabus will be provided via the Canvas platform. Such changes may include those required by policy changes, changes in the speed of course coverage, university closure, errors in previous syllabus versions, and other reasons.

Standardized Syllabus Content

COVID-19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the UF Health Screen, Test & Protect website at <https://coronavirus.ufhealth.org/screen-test-protect-2/frequently-asked-questions/covid-19-exposure-and-symptoms-who-do-i-call-if/> for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

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 Evaluations

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/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

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 Undergraduate/Graduate Program Coordinator

- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@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@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 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, Various ways to receive assistance with respect to using the libraries or finding resources.

<http://cms.uflib.ufl.edu/ask>

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>