

Radiation Interactions and Sources 1
ENU 4605, Class 12512, Section 1747, Fall 2023
MW 0935-1130 (UF Periods 3 and 4)
WEIL 0238
Final Exam 12/13/2023 1000-1200 in WEIL 0238

1 Instructor

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Office Hours: MTWR 1400-1500, and by appointment. Beginning and end times of office hours will be enforced strictly. If you would like to meet on Zoom, please send me a message on Teams.

2 Course Description

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

3 Course Prerequisites

None

4 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

5 Professional Component (ABET)

4 credits of engineering topics

6 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

7 Recommended Textbook

Atoms, Radiation and Radiation Protection

James E. Turner

2007, 3rd edition

ISBN 978-3-527-40606-7

Free PDF available at <https://onlinelibrary.wiley.com/doi/book/10.1002/9783527616978>

Must be on UF network or UF VPN.

Referred to as (T) in course materials

8 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

Free PDF available at <https://onlinelibrary.wiley.com/doi/book/10.1002/9783527617135>

Must be on UF network or UF VPN.

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

9 Lecture Schedule

Module 1: Introduction

Module 2: Nuclear Physics

Module 3: Radioactive Decay

Module 4: Photon Interactions

Module 5: Charged Particle Interactions

Module 6: Neutron Interactions

Module 7: Characterization of Radiation

Date	Module	Due	(Lecture #) Topic	Reading
Aug 23	1		(1) Introduction to course	(T) Ch. 1
Aug 28	1		(2) Atomic structure & atomic radiation	(T) Ch. 2
Aug 30	1		(3) Types of radiation, flux and fluence	(T) Ch. 2
Sep 4			Labor Day (No Class)	
Sep 6	2	HW 1	(4) Nuclear structure, chart of nuclides	(T) Ch. 3
Sep 11	2		(5) Binding energy	(T) Ch. 3
Sep 13	2		(6) Nuclear equations (Q-values)	(T) Ch. 3
Sep 18	2		(7) α , β , and γ radiation	(T) Ch. 3
Sep 20	3	HW 2	(8) Activity	(T) Ch. 4
Sep 25	3		(9) Radioactive series decay	(T) Ch. 4
Sep 27			(10) Equilibrium	
Oct 2	4	HW 3	(11) Photon attenuation	(T) Ch. 8
Oct 4	4		(12) Photoelectric effect	(T) Ch. 8
Oct 9			Exam 1 Review	
Oct 11			Exam 1 (Modules 1-3)	
Oct 16	4		(13) Compton scattering	(T) Ch. 8
Oct 18	4		(14) Pair production	(T) Ch. 8
Oct 23	5	HW 4	(15) Heavy charged particles	(T) Ch. 5
Oct 25	5		(16) Heavy charged particles	(T) Ch. 5
Oct 30	5		(17) Electron interactions	(T) Ch. 6
Nov 1	5		(18) Charged particle track phenomena	(T) Ch. 7
Nov 6	6	HW 5	(19) Neutron sources & classifications	(T) Ch. 9
Nov 8	6		(20) Neutron interactions	(T) Ch. 9
Nov 13	6		(21) Fission	(T) Ch. 9
Nov 15	6		(22) Criticality	(T) Ch. 9
Nov 20			Exam 2 Review	
Nov 22			Thanksgiving (No Class)	
Nov 27			Exam 2 (Modules 4-5)	
Nov 29	7	HW 6	(23) Dosimetric quantities	(T) Ch. 12
Dec 4	7		(24) Shielding and buildup factors	(T) Ch. 15
Dec 6			Final Exam Review	
Dec 13			Final Exam (7:30 am to 9:30 am)	

9.1 Module Reference Guide

Sometimes you may want to read how more than one reference explains a topic. This section helps you quickly find the relevant topic in other references that I have found useful over the years.

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

10 Grading

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

- (6) Homework Assignments – 250 points (50 each; lowest HW grade dropped automatically)
- (2) During Term Exams – 500 points (250 each)
- (1) Final Exam – 250 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>

11 Course Policies

11.1 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.

11.2 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.

11.3 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

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.

11.4 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.

12 Standardized Syllabus Content

The following statements were required to be inserted into all syllabi by the HWCOE and/or UF. While you may ask me questions about the statements, I may have to refer you to the appropriate UF unit responsible for the statement.

12.1 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.

12.2 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.ua.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.ua.ufl.edu/public-results/>.

12.3 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.

12.4 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.

12.5 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

12.6 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.

12.7 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>

12.8 Campus Resources

12.8.1 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/>

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

<https://care.dso.ufl.edu>

On-Line Students Complaints:

<https://distance.ufl.edu/state-authorization-status/#student-complaint>

13 Changelog

[1.0] - 2023-07-19

- Original version