

Nuclear Radiation Detection and Instrumentation

ENU 5615C, Class DEPT, Spring 2024

TR 0830-1025 (UF Periods 2-3) MAEB 0229 (lecture) or RHN B17 (laboratory)

TR 1040-1130 (UF Period 4) RHN B17 (laboratory)

Final Exam 05/02/2024 1230-1430 in MAEB 0229

1 Instructor

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Office Hours: TBD, 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

Interaction of radiation with matter, radiation-detection systems, pulse shaping, amplification, amplitude and time-analyzing circuitry; counting and measuring devices and control systems for nuclear reactors.

3 Course Prerequisites

Prereq: ENU 3003 and EEL 3303L or equivalent

Coreq: ENU 6051 or ENU 4605

4 Course Objectives

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

- Principles of radiation interactions with matter
- Radiation detection techniques
- Characteristics of radiation detections
- Students will have developed communication skills, including technical writing and oral presentations

5 Recommended Textbook

Radiation Detection and Measurement

Glenn Knoll

Wiley, 4th edition (2010)

ISBN 978-0470131480

6 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.

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.

Fundamentals of Nuclear Engineering
J. Kenneth Shultis and Richard E. Faw
Marcel Dekker, Inc. New York, 2016
ISBN 978-1-498-76929-7

7 Course Schedule

There will be two types of sessions in this course:

1. **Lecture Sessions:** Two-period lecture sessions will include a lecture (often using Power-Point) and working example problems on the board. You should read the textbook chapters/sections before the associated lecture.
2. **Laboratory Sessions:** Three-period laboratory sessions will occur during particular weeks as noted on the course schedule.

The course outline and schedule below is subject to change depending on the speed in which material is covered.

Week	Day	Date	Textbook	Material
1	T	Jan 9	Ch. 1 & Ch. 2	Introduction & Sources of Radiation & Radiation Interactions
1	R	Jan 11	Ch. 3	Counting Statistics & Error Prediction
2	T	Jan 16	Ch. 4	General Properties of Radiation Detectors
2	R	Jan 18	Ch. 5	Gas Detectors (Ionization Chambers)
3	T	Jan 23	Ch. 6	Gas Detectors (Proportional Counters)
3	R	Jan 25	Ch. 7	Gas Detectors (G-M Tubes)
4	T	Jan 30	Ch. 8	Scintillation Detector Principles
4	R	Feb 1	Ch. 9	Photomultiplier Tubes and Photodiodes
5	T	Feb 6	Ch. 10	Spectroscopy with Scintillators
5	R	Feb 8	Ch. 11	Semiconductor Diode Detectors
6	T	Feb 13		Exam 1 (Ch. 1-10)
6	R	Feb 15	Ch. 12	Germanium Gamma-Ray Detectors
7	T	Feb 20	Ch. 14	Slow Neutron Detection Methods
7	R	Feb 22	Ch. 15	Fast Neutron Detection and Spectroscopy
8	T	Feb 27	Ch. 16	Pulse Processing
8	R	Feb 29	Ch. 17	Pulse Shaping, Counting, and Timing
9	T	Mar 5	Ch. 18	Multichannel Pulse Analysis
9	R	Mar 7		Exam 2 (Ch. 11-12, 14-17)
10	T	Mar 12		No Class (UF Holiday/Spring Break)
10	R	Mar 14		No Class (UF Holiday/Spring Break)
11	T	Mar 19		Lab 1 - Group 1
11	R	Mar 21		Lab 1 - Group 1
12	T	Mar 26		Lab 2 - Group 1
12	R	Mar 28		Lab 2 - Group 2
13	T	Apr 2		Lab 3 - Group 1
13	R	Apr 4		Lab 3 - Group 2
14	T	Apr 9		Lab 4 - Group 1
14	R	Apr 11		Lab 4 - Group 2
15	T	Apr 16		Lab 5 - Group 1
15	R	Apr 18		Lab 5 - Group 2
16	T	Apr 23		Formal Report Q&A
17	T	May 2		Final Exam

8 Grading

Assessments in this course are worth a total of 1000 points.

Note that you must receive greater than 330 points in in each portion of the course in order to receive a passing grade (e.g. 500 points in lecture and 300 points in lab does not equal a B. It will be recorded as an E). Below is a breakdown for the point values for each assessment.

Lecture Assessments

- (2) Exams – 200 points (100 points each)
- (10) In-Class Exercises – 100 points (10 points each; highest 10 count)
- (1) Mock Short Report – 100 points
- (1) Critical Analysis of Journal Article – 100 points

Laboratory Assessments

- (1) Worksheet – 50 points
- (2) Short Reports – 200 points (100 points each)
- (1) Formal Report – 150 points
- (1) Oral Presentation – 100 points

Final grades will be assigned using 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

Please note the following:

1. Grading in this course is plus-based. You are awarded points at each correct step, rather than deducting points for errors. Note that points are awarded for correct steps, and getting the correct final answer. That is, an error at an intermediate step will prevent you from earning points for that step and for the final answer.
2. The grade cut-offs for A, B, and C are lower than some typical scales (90, 80, 70, etc.) under which many UF courses operate. The intention is not to inflate grades, but rather to account for the challenging nature of the course.
3. The gradebook on Canvas is not official. I reserve the right to correct errors, including transcription errors, from the official (spreadsheet) gradebook, until finalization of grades with the UF registrar.

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

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

8.1 Lecture Grading

8.1.1 Exams

There will be two midterm exams given during the semester on the tentative date shown on the schedule. Before each midterm exam and the final exam, you will receive an exam preview through PowerPoint slides and/or PDF document. This will cover the procedures for the exam as well as a preview of the technical content that will be included.

No collaboration is permitted during the exams, though you may prepare before however you choose. Use of any unauthorized materials or any communications is grounds for being reported to Student Conduct & Conflict Resolution for a violation of the UF Honor Code.

The criteria for make-up exams are the same as for extensions to other assignments. All make-up exams will be held after the regular exam, as organized with me.

8.2 Laboratory Grading

8.2.1 Lab Participation

I expect all students to come to lab on-time and prepared to perform the experiment. I expect students to contribute to the execution of each experiment/measurement (i.e. coming to lab and watching is not an effective form of lab participation).

I also expect students to keep a detailed laboratory notebook or binder that contains everything from the course. This should have at a minimum all data you record or print out that is associated with the course. Equipment information and sketches of experiment setups should also be included along with any information that helps you explain your results. This will help you prepare your reports and presentations. Keeping your "laboratory notebook" in electronic form is also acceptable.

Excused absences from laboratory exercises will be accommodated by obtaining data from their other group member(s). The absent student is still responsible for the corresponding deliverable (i.e., worksheet, short report, formal report, oral presentation).

Unexcused absences from laboratory exercises will be accommodated by obtaining data from their other group member(s). The absent student is still responsible for the corresponding deliverable (i.e., worksheet, short report, formal report, oral presentation), but will incur a penalty of 20% deduction of the maximum point value that deliverable (e.g., a short report would have a 20 point deduction).

8.2.2 Short Reports

Short reports are abbreviated formal reports. No abstract, theory section or procedure section is required, but the Results and Analysis section should be thorough and well written—just as you would write for a long (formal) report. Adequate explanation and discussion of all parts of the lab is necessary. I you give some notes for writing short reports. Short reports are due one week after the experiment is performed. You will have 3 short laboratory reports throughout the semester. These reports will be approximately 10 pages in length (assuming single spacing), with extensive use of figures, graphs, and tables to provide adequate explanation of the results from the experiment, including linking your observations with theory.

8.2.3 Long (Formal) Report

The formal report for experiment is essentially a report designed to demonstrate your knowledge of the experiment, from theory to data analysis and everything in between. The long report will include an abstract, theory section and a procedure section in addition to the sections mentioned for short reports. This report will be more detailed and thus will be much longer than your previous reports. I will give you some notes for writing the long report later in the semester.

8.2.4 Oral Presentation

To help you prepare for future careers, where you will need to make presentations to your supervisor or at a conference, you will prepare an oral presentation. For these experiments you will prepare a 15 minute PowerPoint presentation about the experiment including the theory, your experimental setup, measurement results, and analysis of your results. You will then be asked a few questions by the Instructor concerning what you should have learned during the experiment. Make sure you come to the presentation prepared (I suggest you look over the results and underlying theory) as these presentations will be done individually. You shall schedule the presentation during the following week after the experiment was performed.

9 Course Policies

9.1 Attendance

Attendance is strongly recommended starting on the first day of class. 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 graduate catalog

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>
and require appropriate documentation.

9.2 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 20% 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.

9.3 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.

9.4 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.

10 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.

10.1 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.

10.2 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/>.

10.3 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.

10.4 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.

10.5 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

- HWCoe Human Resources, 352-392-0904, student-support-hr@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

10.6 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.

10.7 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>

10.8 Campus Resources

10.8.1 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/>

10.8.2 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>

11 Changelog

[1.0] - 2023-11-15

- Original version