

Radiation Interactions and Sources 1
ENU 5005, Class 28286, Section INE2, Fall 2023
TR 0935-1130 (UF Periods 3 and 4)
Room TBD
Final Exam 12/11/2023 1500-1700 in Room TBD

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

Students will learn atomic and nuclear physics, interaction of radiation with matter, detecting nuclear radiation, neutron diffusion and moderation, nuclear reactor theory, time dependent reactor theory, and two-phase flow and heat transfer at a level appropriate to begin graduate-level coursework in nuclear engineering sciences.

3 Course Prerequisites

None

4 Course Objectives

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

- Students will develop a familiarity with basic topics in atomic and nuclear physics
- Students will develop a familiarity with basic topics in interaction of radiation with matter
- Students will develop a familiarity with basic topics in detecting nuclear radiation
- Students will develop a familiarity with basic topics in neutron diffusion and moderation
- Students will develop a familiarity with basic topics in nuclear reactor theory
- Students will develop a familiarity with basic topics in time dependent reactor theory
- Students will develop a familiarity with basic topics in two-phase flow and heat transfer

5 Recommended Textbook

None

6 References

1. Atoms, Radiation and Radiation Protection, James E. Turner, 2007, Third Edition, ISBN 978-3-527-40606-7. Free PDF available at <https://onlinelibrary.wiley.com/doi/book/10.1002/9783527616978>
2. Fundamentals of Nuclear Engineering, J. Kenneth Shultis and Richard E. Faw, 2016, Third Edition, ISBN 978-1-498-76929-7
3. Radiation Detection and Measurement, Glenn Knoll, 2010, Fourth Edition, ISBN 978-0-470-13148-0
4. Introduction to Nuclear Engineering, John R. Lamarsh and Anthony J. Baratta, 2018, Fourth Edition, 0134570057
5. Nuclear Systems I: Thermal Hydraulic Fundamentals, N.E. Todreas and M.S. Kazimi, 2011 (2nd edition). (ISBN: 9781439808870)

7 Lecture Schedule

Module 1: Atomic and nuclear physics,
 Module 2: Interaction of radiation with matter
 Module 3: Radiation detection
 Module 4: Neutron diffusion and moderation
 Module 5: Nuclear reactor theory
 Module 6: Time dependent reactor theory
 Module 7: Two phase flow and heat transfer

Date	Module	Due	(Lecture #) Topic
Aug 24	1		(1) Introduction to course & fundamental material
Aug 29	1		(2) Radiation, radioactive decay, kinetics, units
Aug 31	1		(3) Binding energy, nuclear equations (Q-values)
Sep 5	2	HW 1	(4) Radioactive series decay and equilibrium
Sep 7	2		(5) Photon interactions
Sep 12	2		(6) Heavy charged particles and electrons
Sep 14	2		(7) Neutron interactions, radiation dose, KERMA, fission
Sep 19	3	HW 2	(8) Introduction to radiation detection
Sep 21	3		(9) Counting statistics
Sep 26	3	Exam 1	(10) General detector properties
Sep 28	3		(11) Gas detectors
Oct 3	3		(12) Scintillation detectors
Oct 5	3		(13) Semiconductor detectors
Oct 10	3		(14) Neutron detectors
Oct 12	4	HW 3	(15) Neutron cross sections
Oct 17	4		(16) Fission chain reaction and criticality
Oct 19	4	Exam 2	(17) Diffusion equation
Oct 24	5	HW 4	(18) One-group reactor equation, slab reactor, other shapes
Oct 26	5		(19) One-group critical equation, thermal reactors
Oct 31	5		(20) Reflected reactors, multi-group calculations
Nov 2	5		(21) Applications to practical problems
Nov 7	6	HW 5	(22) Classification of time problems, reactor kinetics
Nov 9	6		(23) Control rods, chemical shim, temperature effects on reactivity
Nov 14	6		(24) Fission product poisoning, core properties during lifetime
Nov 16	7	HW 6	(25) Averaging, parameters, transport in two-phase flow
Nov 21	7		(26) Modeling two-phase flow, pressure loss in two-phase flow
Nov 23			Thanksgiving (No Class)
Nov 28	7	Exam 3	(27) Boiling, fundamentals, correlations, CHF
Nov 30	7		(28) Heat transport in nuclear fuel, pellets, gap, clad
Dec 5		HW 7	(29) Fluid mechanics and heat transfer, SCA
Dec 11			Final Exam (3:00 pm to 5:00 pm)

8 Grading

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

- (7) Homework Assignments – 175 points (25 each)
- (3) Exams – 600 points (200 each)
- (1) Final Exam – 225 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>

9 Course Policies

9.1 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.

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 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.

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

- 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

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] - 2023-07-19

- Original version