NRE 3301 – Radiation Physics
(Fall 2026)

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Office Location: Boggs 3-85
Office Hours: T/Th 1:30 – 3:30 or by appointment (always best)
I am happy to meet in-person, over the phone, or via Teams or some other platform

Course Description
This course will acquaint students with basic atomic and nuclear physics concepts. The students will be able to apply the basic theories of atomic physics including the special theory of relativity, wave particle duality, models of the atom, uncertainty and exclusion principles to radiation physics. Students will learn the basic concepts related to binding energy, mass defect, binding energy curve, Q-values and energetics of nuclear reactions. The course will enable students to do quantitative assessment of radioactivity. Students will solve problems in nuclear and radiological engineering dealing with radioactive decay, activity, half-life, decay constant, different types of decay mechanisms, and radioactive equilibrium. The course will cover ionizing radiation with matter, dose and exposure and the relationship with biological damage, and radiation shielding analysis. Internal dosimetry and radiological dispersal will also be examined. Students will get a basic understanding of both fission and fusion.

Prerequisites
MATH 1552
Physics 2211
NRE 2120

Course Details
Term: Fall 2026
Course name: Radiation Physics
CRN: 90534
Course number: NRE 3301
Section number: A
Meeting times: Monday/Wednesday 3:30 pm – 4:45 pm
Room building & number: Manufacture Rel Discip Complex (3403)

Learning Objectives
Upon successful completion of this course, students should be able to:
1. Apply the basic theories of atomic physics including the special theory of relativity, wave particle duality, models of the atom, uncertainty and exclusion principles to radiation physics
2. Apply the basic concepts in nuclear physics including nuclear models, binding energy, mass defect, binding energy curve, nuclear reactions, Q-values and energetics of nuclear reactions
3. Solve problems related to the radioactive decay law, activities, half-lives, decay chains, and radioactive equilibrium
4. Calculate radiation dose (internal and external) and exposure quantities
5. Solve problems related to radiation shielding
6. Understand fission and fusion reactions

Textbook
James E. Martin, Physics for Radiation Protection, Third Completely Updated Edition; Wiley-VCH Verlag

GmbH & Co. KGaA, 2013.

OR

J. Turner, Atoms, Radiation, and Radiation Protection, Third Edition, 2007, 978-3-527-40606-7.

Other books, reviews, and papers indicated in lecture notes and/or posted on Canvas. NOTE: Most lectures use outside sources in addition to (or instead of) the textbook. Canvas will be used as the course website to communicate with the students.

Grading

Exams (2):	40%
Final Exam:	20%
HW & Quizzes:	30%
Project:	10%

Grade Scale: A: (90-100), B: (80-89), C: (70-79), D: (60-69), F: (0-59)

Attendance Policy

Students are expected to attend all classes for their full length. If a student is unable to attend a class for whatever reason, it is the student's responsibility to acquire any missed notes, lecture materials, or other information disseminated in class. If you know in advance that you will not be able to attend a class, please let me know so that you can avoid getting a zero on an unannounced quiz (see below regarding missed quizzes).

Most lectures will be streamed on Microsoft Teams, and students who are unable to physically make it to class for whatever reason can login and participate remotely. This does NOT substitute for face-to-face attendance. Rather, this provides you the student with the benefit of (1) still taking part in class if you are unable to physically attend and (2) having a recording of the lecture so that you can review it if needed.

I do NOT DISTRIBUTE my personal notes, lecture materials, or problem solutions, so if you miss class you must get this information from another student.

Homework

Regarding late work: I realize that unforeseen events happen and situations arise. Late work can be turned in within 24 hours of the due date for a maximum grade of 50%. The assignment will not be accepted after 24 hours from the due date and will receive a zero. However, there are times when I will review the homework within this 1-day window. If this happens, then I can no longer accept the assignment, and it will automatically receive a zero. Obviously, there are exceptions at my discretion, but if something comes up that hinders you from turning in the HW on time, the earlier you let me know the better chance I can accommodate you.

Note that homework is **sometimes** graded on **effort & completeness**, rather than accuracy. Thus, it is usually in your best interest to submit an incomplete assignment on time, rather than a complete assignment late. Homework should be submitted at the start of class unless an instant arises where an electronic copy can be submitted to Canvas or emailed directly to the instructor in PDF format.

Quizzes

Quizzes may be given throughout the term either in-person or via Canvas. In-person quizzes will not be announced. If the quiz is given online, then you will have a certain time window (usually a few days) to complete the quiz. I will alert the class when a quiz has been posted, and once a quiz has been made available, I highly encourage you to take it at your earliest availability rather than wait. Note that I have **never extended** a quiz for an individual who simply forgot to take it.

The time allotted for all quizzes is short, generally about 15-20 minutes. Although the quiz will close on Canvas after the allotted time, you can still submit any work you have done for partial credit (and I highly encourage this). However, the submitted work must align with any answers you have submitted, thus you **must submit something** to Canvas in order to receive partial credit. If what you submit to Canvas does not align with work that you submit, this amounts to cheating (see Cheating & Honor Code below). A student can always choose to come to my office and take a quiz in-person rather than online, but you must request this in a timely manner in order to ensure instructor availability.

Points awarded on Homework and Quiz assignments will sum to give the total towards the final grade

For example, if you have the following scores:
HW1: 42/45
HW2: 55/55
HW3: 0/55
Quiz1: 10/10
Quiz2: 5/10

Fraction of total points earned: $\frac{42+55+0+10+5}{45+55+55+10+10} = 0.64$

Total HW/Quiz points towards final grade: $(0.64)(30) = 19.2$

Points awarded on the exams (not including the final) will sum in a similar fashion.

Project
All students must request the MCNPv6.3 code immediately as this may take several weeks to obtain approval.

Project details will be given out later since the exact nature of the project(s) may vary depending on how the semester unfolds. If the project includes a presentation, all students are expected to be present for ALL project presentations. Students not present at the time when THEIR presentation is supposed to be given will receive a 10% deduction on the project grade. Students not present at the time when OTHER presentations are supposed to be given will receive a 2% deduction from their project grade for each presentation they miss. The student must make arrangements with the instructor prior to the project presentation dates to receive an excused absence. Project presentations will likely take place the last week of the term. Note that we will spend at least one full class period working on the project, and students not present will receive a 5% deduction from the student's project grade.

Tests and Final Exam
All students are expected to be present at the time exams are given. Students not present at the time when an exam is given will receive a "0" for that exam. No make-up exams will be given unless the student makes arrangements with the instructor prior to the exam date to receive an excused absence. The students will be informed when an exam will take place at least one week before the exam. The format for the tests and the final will be explained at this time.

Extra Credit
Certain homework and exams may have extra credit problems that the student can choose to perform if they wish. There will NOT be an extra credit assignment.

Cheating & Honor Code
Students are expected to abide by all policies set by the instructor regarding what is permitted and what is not

permitted for all assignments. Unless explicitly stated otherwise, students must always abide by the following:

- Homework: students can work alone or in groups, but each student must submit only their individual work. Copying is never allowed.
- Quizzes: students must work alone. Students cannot seek outside assistance and can only ask the instructor for guidance/help.
- Tests/Final: students must work alone. Students cannot seek outside assistance and can only ask the instructor for guidance/help.

Outside assistance includes utilization of websites and other tools. If you are unsure of something, just ask. Violation of any of the above will constitute a "0" grade on the assignment as well as notification of the College Dean and Department Head.

The Honor Code can be found at: http://www.honor.gatech.edu

Course Outline

Week	Description
1	Structure of Atoms; Radiation Basics
2	Nuclear Models; Relativity; Binding Energy
3	Radioactivity & Transformations
4/5	Nuclear Interactions & Processes; cross sections (Exam 1)
5	Naturally Occurring Radiation
6	Interactions of Charged Particles with Matter (stopping power; dose and exposure)
7	Interactions of Photons with Matter (dose and exposure)
8	Charged Particle and Photon Shielding
9	Internal Dosimetry (Exam 2)
10	Review & Work on Project (**attendance required**); Neutron Dosimetry
11	Neutron Dosimetry and Shielding
12	Environmental Dispersion
13	Particle Accelerators & Isotope Separators
14	Nuclear Fission & Fusion
15	Project Presentations / Review
	Time Permitting: Intro to Radiation Detection & Measurement
	Final Exam: TBD See Registrar for official listing

The above schedule is tentative, and subject to change at any time.

Additional Information

GT Policy on Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodations, contact the Office of Disability Services at (404) 894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodation letter. Please also e-mail me as soon as possible to set up a time to discuss your learning needs.

GT Policy on Excused Absences for Religious Observances

Georgia Tech policy on excused absences for religious observances: http://www.catalog.gatech.edu/rules/4/: "Students who are absent because of participation in a particular religious observance will be permitted to make up the work missed during their absence with no late penalty, provided the student informs the course instructor of the upcoming absence, in writing, within the first two weeks of class, and provided the student makes up the missed material within the timeframe established by the course instructor."

GT Policy on Absences for Medical Reasons
GT policy on absences for medical reasons. http://www.catalog.gatech.edu/rules/4/ Students will work with the Office of VP for Student Life (Dean of Students) to have them verify that the student was ill 3 and to determine the severity of the problem; the Dean's office will then interact with the instructor(s) if necessary. To the extent possible, requests from the Office of the Dean of Students to excuse a medical emergency or illness and allow make-up of the work missed, including homework, examinations, or other class assignments will be accommodated.

Policy on Unforeseen or Emergency Situations
If due to an unfortunate unplanned emergency such as a car accident, a theft or burglary in your apartment, you are unable to attend an exam at the last minute, a police report substantiating the accident or mishap must be provided. Requests for accommodating an absence that are made after the exam will under almost all circumstances, without the above documentation, not be honored. Under the unlikely and highly discouraged event that you have to miss the final exam, alternate arrangements will be made on a case-by-case basis, including, but not limited to, a one-on-one oral exam of appropriate duration, to test your knowledge in the subject matter.

Student-Faculty Expectations Agreement
At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See http://www.catalog.gatech.edu/rules/22/ for an articulation of some basic expectation that you can have of faculty and that faculty have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, we encourage you to remain committed to the ideals of Georgia Tech while in this class.

Campus Resources for Students
The CARE Center and the Counseling Center, Stamps Health Services, and the Dean of Students Office will offer both in-person and virtual appointments. Student Center services and operations are available on the Student Center website. For more information on these and other student services, contact the Dean of Students or the Division of Student Life.

Mental Health & Wellness
As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, depression, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. GT offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know is experiencing any of the issues noted above, consider utilizing the confidential mental health services available on campus. I encourage you to reach out to GT CARE (www.care.gatech.edu, 404-894-3498) or the Counseling Center (www.counseling.gatech.edu, 404-894-2575) for support. An on-campus counselor or after-hours services are available to assist you.