NRE 2120 – Elements of Nuclear Science and Engineering (Summer 2026)

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Office Hours: Appointment only. I am happy to meet in-person, over the phone, or via Teams or some other platform.

Course Description
Nuclear technologies have a positive impact on society through clean electrical production, industrial applications, and medical practice. This course provides understanding of the fundamentals that influence the application of these technologies. This course will cover nuclear and radiation engineering fundamentals and applications. Fundamentals will include basics of the atom, nuclear cross-sections, interaction rates, radioactive decay, and neutron multiplication. Applications include nuclear power, radiation detection, and nuclear medicine.

Prerequisites
MATH 1551
Physics 2211 (with concurrency)

Course Details
Term: Summer 2026
Course name: Elements of Nuclear Science and Engineering
Course number: NRE 2120
CRN (in-person): 57058
CRN (online): 56623
Section number (in-person): A
Section number (online): QUP
Meeting times: Tuesday/Thursday 9:30 pm – 11:40 pm
Room building & number: J. Erskine Love Manufacturing 184

Learning Objectives
Upon successful completion of this course, students should be able to:

1. summarize multiple applications of nuclear technologies in a wide range of disciplines including medicine, space exploration, power production, and military defense
2. explain the principles involved with generating power from nuclear fission
3. solve a limited set of real problems encountered in the nuclear engineering field
4. calculate neutron interaction rates in multi-element homogeneous media
5. calculate neutron criticality (k_{eff}) in multi-element homogeneous media

Textbook
Masterson R.E. (2017) Nuclear Engineering Fundamentals: A Practical Perspective (CRC Press)
This textbook is free for GTech students and can be accessed at the below link.
https://www.taylorfrancis.com/books/mono/10.1201/9781315156781/nuclear-engineering-fundamentals-robert-masterson

OR

Murray, R. L. & Holbert, K. E., Nuclear Energy: An Introduction to the Concepts, Systems, and

Applications of Nuclear Processes, 8th Edition, Elsevier Inc. 2020, ISBN: 978-0-12-812881-7

Additional Materials/Resources
Lamarsh J.R. and Baratta A.J. (2001) Introduction to Nuclear Engineering 3rd Edition (Pearson)

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:	35%
Project:	5%

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

Attendance Policy
Some lectures will be streamed and recorded in real-time on Microsoft Teams and then uploaded to Canvas. Other lectures will be prerecorded and then uploaded to Canvas. Students are required to participate for all real-time lectures.

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 and/or post the solutions 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 **largely** 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 to Canvas in PDF format.

Quizzes
Quizzes will be given throughout the term via Canvas. These online quizzes will have a certain time window (usually a few days) to complete the quiz. The time allotted for all quizzes is short, generally about 15-20 minutes. 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.

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: $(0.64)(35) = 22.4$

Project
Project details will be given out later since the exact nature of the project(s) may vary depending on how the semester unfolds.

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. Exams will take place during the normally scheduled class time. 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 and duration of the exams will be explained at this time. The Final Exam is set by the university Registrars Office.

Points awarded on Exams (excluding the Final) will sum to give the total towards the final grade

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	Dates	Description
1	May 19/21	Introduction & History of Nuclear Science / The Atom & Nucleus
2	May 26/28	Nuclear Interactions & Reaction Rates / Cross Sections (neutrons & photons)
3	June 2/4	Radioactive Decay / Radiation Detectors
4	June 9/11	Radiation Exposure & Dose / **Exam 1**
5	June 16/18	Fission & Chain Reactions / Life of a Neutron (diffusion) and 4&6 Factor Formulas
6	June 23/25	Nuclear Reactor Fundamentals / BWRs & PWRs / AP1000 & Other Advanced Designs
7	June 30/ July 2	**Exam 2** / Nuclear Fuel Cycle
8	July 7/9	Nuclear Fuel Cycle
9	July 14/16	Nuclear Fuel Cycle
10	July 21/23	Nuclear Fuel Cycle
11	July 28	Special Topics
12	July 29	Review (last day of class)
		Final Exam: TBD
		Time Permitting
		Nuclear Medicine & Accelerators
		Nuclear Weapons (time permitting)

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.