

NRE 6101 Syllabus

Transport Fundamentals, NRE 6101

Fall 2026

Instructor Information

Instructor: Farzad Rahnema
Email address: farzad@gatech.edu

General Course Information

Description

This course deals with the description of neutral particle transport in materials in steady state monoenergetic problems. First, we provide a high-level description of the types of neutron interaction with matter. Then, having the interaction probability, we derive the neutral (e.g., neutron) transport equation, also known as the Boltzmann transport equation and discuss its general properties. Next, we reduce this equation to its simplest form, i.e., energy independent in steady state slab geometry. We conclude the course by discussing the most common approximate forms of the transport equation used to solve practical radiation transport problems, with emphasis on those used by the nuclear industry to solve operating reactor core neutronic problems.

Course Learning Outcomes

- Develop an understanding of neutral particles transport in matter
- Learn particle distribution functions dependent on its position, energy, time, and direction of travel
- Learn how to derive both the integrodifferential and integral particle transport equations in various geometries
- Learn the general properties of the transport equation
- Learn various approximate transport solution methods such as spherical harmonics, asymptotic, diffusion, discrete ordinates, collision probability, other methods, time permitting

Required Course Materials

Textbook: Computational Methods of Neutron Transport, Lewis and Miller, John Wiley & Sons Inc. (1984).

Other references:

1. Bell, G/ and Glasstone, S., "Nuclear Reactor Theory", Van Nostrand Reinhold (1970) – Available online.
2. Duderstadt, J. J., and Hamilton, L. J., "Nuclear Reactor Analysis", John Wiley (1976).
3. Henry, A., "Nuclear Reactor Analysis", MIT Press (1975)

Grading Policy:

- Homework problems (30%)
- Midterm exam (35%)

Research Project (35%)

A: > 90, B: >80, C: >70, D: >70

Description of Graded Components

The midterm exam is class and closed book and notes. The research is to review one or two assigned journal papers and submit a summary of the research (1 to 2 pages) followed by an MS PowerPoint presentation that includes time for answering questions. The project is to be conducted individually with no collaboration with others.

Course Policies

Attendance and/or Participation

This will be an active classroom, where you will be expected to participate. I have noticed a drastic difference in the exam performance between students who regularly attend class and those who don't. Therefore, I will count attendance in determining your final grade.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review [Academic Honor Code | Georgia Tech Catalog](#) and the student [Code of Conduct | Georgia Tech Catalog](#).

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services [Home | Disability Services](#) (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

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. The [Student-Faculty Expectations | Georgia Tech Catalog](#) articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Pre- &/or Co-Requisites

Graduate standing in engineering or related disciplines.

Collaboration, Group Work, and Use of Generative AI

You are allowed to work in groups on all homework, but any work you turn in must be written in your own hand. In-class exams are to be your own work. All in-class and exams will be closed book and notes.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Late homework will be penalized accordingly. Make-up exams are given for illness, approved Institute activities, or religious observances.