NRE4210 Syllabus

[Nuclear Reactor Physics II, Section A, 3 Credits]

[Class Day(s) T/Th**, Time** 3:00-4:15 PM**, Location** Room XXX XXX building**]**

Instructor Information

Instructor	Email	Office Hours & Location
Professor Dan Kotlyar	dan.kotlyar @me.gatech.edu	Tu 12:30 to 1:30 PM (prior notification by E-mail is recommended), or by appointment Boggs building 3-73
Teaching Assistant(s)	**Email**	**Office Hours & Location**
None	None	None

General Information

Description

The goal of this course is to describe the physical concepts, nuclear data and computational methodology required to understand the design process of current fleet of nuclear reactors. The goal of this senior level course is to provide a comprehensive, detailed, and advanced development of the principal topics of nuclear reactor physics. The course emphasizes the theoretical bases for the advanced computational methods of reactor physics. This course will prepare students for graduate courses within the NRE curriculum.

This course will cover physical concepts and their application to explain nuclear reactor behavior. The course will present useful theoretical and numerical methods to model the behavior of nuclear fission reactors. The aim of this course is to describe the methodologies adopted in various nuclear computational codes. The multi-group diffusion theory, which is the main tool, will be generalized. Time-dependent behavior under steady-state and transient conditions will also be included. The students will gain understanding of full core analysis with time-dependent and thermal-hydraulic feedback. Many numerical examples will be developed by the students to understand the nuclear reactor modeling process.

Pre- &/or Co-Requisites

NRE 3208 Nuclear Reactor Physics I, MATH 2552 Differential Equations (Minimum grade C)

Course Goals and Learning Outcomes

At the completion of this course, students will be able to:

1. Comprehend and use relevant mathematics and tools for reactor physics modeling.
2. Explain the relationships among variables underlying the theory of nuclear fission reactors using analytic and numerical mathematical models and their associated physical behaviors.
3. Solve static reactor physics problems using the multi-group diffusion theory.
4. Solve point reactors dynamic equations and analyze the stability of various systems.
5. Generate group constants for heterogeneous lattices and their applicability in full core calculations.

Course Requirements & Grading

Assignment	Date	Weight (Percentage, points, etc)
Assignment (x6)	Assigned as per class schedule	10% of total grade
Project (x3)	Assigned as per class schedule	20% of total grade
Quiz 1	Week 5 of class	20% of total grade
Quiz 2	Week 10 of class	20% of total grade
Final Exam	Assigned as per Registrar's schedule	30% of total grade

Description of Graded Components

Quizzes (40%)

There will be two quizzes (each 20%) over the semester, given on Thursdays. The quizzes will last for 75 minutes and will make sure that the students have a profound grasp of the material. The quizzes will mainly rely on the home assignments and projects. The first quiz will be conducted on week 5 and will include the first eight lectures. The second quiz will include the material covered from week 5 up to week 10. Each of these quizzes will consist of three questions.

Exams (30%)

The final exam will be cumulative. The final exam will consist of 4 questions and will be conducted at the time appointed by the Registrar.

Projects and assignments (30%)

A total of 6 assignments will be given over the semester. The total weight of these assignments is 10%. The students are also required to develop numerical tools for three projects that are focused on solving the transport equation, multi-group equations, and reactor dynamics.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

No curves are anticipated for this course.

Course Materials

Course Text

Nuclear Reactor Analysis, **Authors** J. Duderstadt and L.J. Hamilton; Wiley (1976)

Additional Materials/Resources

Nuclear Reactor Physics, **Author** W.M. Stacey; Wiley (2007)

Course Website and Other Classroom Management Tools

Canvas will be used as the course website to communicate with the students.

Course Expectations & Guidelines

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. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/.

Any student suspected of cheating or plagiarizing 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 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 accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Attendance and/or Participation

Attendance will not be mandatory.

Collaboration & Group Work

Students are expected to turn in their own work for assignments and quizzes, however, discussion among students on understanding of the subjects and topics is encouraged. At all times students are expected to follow the Academic Honor Code (http://www.catalog.gatech.edu/policies/honor-code/)

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

Late assignments will not be accepted and missed exams will not be rescheduled without an Institute approved absence (e.g. field trips and athletic events). Students with medical or family emergencies should contact the Dean of Students. See http://catalog.gatech.edu/rules/4/ for an articulation of the Institute rules.

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 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.

Student Use of Mobile Devices in the Classroom

Use of portable technology during class time is not permitted unless prior arrangement has been made with the course instructor. Please leave your laptop in your bag, turn off your cell phone, and resist the urge to text your mom.

Additional Course Policies

None.

Campus Resources for Students

Academic Advisors(advising.gatech.edu/) in each school help students navigate degree requirements and take advantage of campus resources to ensure their success.

The Center for Academic Success(success.gatech.edu/) offers a variety of academic support services to help students succeed academically at Georgia Tech (e.g. tutoring, peer-led study groups, study skills, etc.).

The Communication Center (communicationcenter.gatech.edu/) provides support for students with respect to developing competency and excellence in written, oral, visual, electronic, and nonverbal communication

The Library (library.gatech.edu) provides students with many services besides borrowing privileges including access to technology and technical assistance, online access to many journals and databases, and subject and personalized research assistance.

The Office of Disability Services(disabilityservices.gatech.edu/) ensures

that students with disabilities have equal access to all programs and activities offered at Georgia Tech. They provide documentation and officially sanctioned requests for accommodation for students

OMED: Educational Services (omed.gatech.edu/) is the unit charged by Georgia Tech with the retention, development, and performance of the complete student learner who is traditionally underrepresented: African American, Hispanic, and Native American. OMED's programming and academic support services are aimed at equipping all students with strategies to navigate the Georgia Tech environment.

The Division of Student Life(studentlife.gatech.edu/) —often referred to as the Office of the Dean of Students —offers resources and support for all students in our community.

Counseling Center	counseling.gatech.edu/	404-894-2575
Dean of Students	studentlife.gatech.edu/	404-385-8772
GT Police	police.gatech.edu/	404-894-2500
Stamps Health Services	health.gatech.edu/	404-894-1420

Course Schedule

Date	Topic	Notes (Reading, Notes, due dates, and more)
Week 1	Neutron transport and the direct solution approach	Text book - Chapter 4
Week 2	Treatment of cross-sections	Lecture notes & Chapter 2
Week 3	Numerical solutions of the transport equation (Part I)	Lecture notes
Week 4	Numerical solutions of the transport equation (Part II)	Lecture notes
Week 5	Quiz 1 Review of the point reactor kinetics equations	Quiz covers weeks 1-5)
Week 6	Reactivity feedback	Text book - Chapter 6
Week 7	Reactor dynamics and stability analysis	Text book - Chapter 6
Week 8	Derivation of the multi-group diffusion theory and simple applications	Text book - Chapter 7
Week 9	Numerical solution of the multi-group equations	Lecture notes
Week 10	Nuclear Reactor Fundamentals, Pressurized Water Reactor	
Week 11	Spring Break	
Week 12	Quiz 2 Neutron slowing down	(Quiz covers weeks 6-10)
Week 13	Fast spectrum calculations: resonance absorption and fast group constants	Text book - Chapter 8
Week 14	Thermal spectrum calculations: models of neutron thermalization	Text book - Chapter 9
Week 15	Nuclear core analysis and calculation models (Part I): parametrization of few-group constants	Text book - Chapter 10
Week 16	Nuclear core analysis and calculation models (Part II): nodal diffusion approach and core power calculations	Lecture notes
Finals	Final Exam	Comprehensive