

NRE4351 Syllabus

[Design of Nuclear and Radiological Systems, Section A, 3 Credits]

[Class Meets: Tentative: Mon 6:00-8:45 PM; Fri 11:15-12:05 and 3:00-5:45 PM, Location TBD]

Instructor Information

Instructor

Professor Bojan Petrovic

Email

bojan.petrovic@gatech.edu

Office Hours & Location

Tentative Mon 1:30 to 2:30 PM
(prior notification by E-mail is recommended), or by appointment
Boggs building 3-07

Teaching Assistant(s)

TBA

Email

TBA

Office Hours & Location

TBA

General Information

Description

This course is the second culminating course in a two course capstone design sequence in the NRE curriculum. Students will work in teams and apply a systematic design process to integrate aspects of nuclear and radiological engineering and design a nuclear or radiological system or facility.

In the NRE Senior Design class, you will be assigned to perform an integrated NRE design of a reactor or a nuclear or radiological facility. You will be expected to perform adequate analyses. For most of design tasks that will require using relatively complex state-of-the-art tools.

Pre- &/or Co-Requisites

NRE 3208, NRE 4XXX Nuclear and Radiological Engineering Design Methods and Tools;
Prerequisites with concurrency: NRE 4214 or NRE 4328

Course Goals and Learning Outcomes

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

- Outcome 1. Students will be able to apply and integrate appropriate methods and knowledge of mathematics, engineering, and in particular nuclear or radiological engineering to perform a design project.
- Outcome 2. Students will be able to complete an open-ended design of a major nuclear or radiological facility, machine or equipment, or associated fuel cycle, and satisfy the given requirements and constraints, while considering relevant engineering aspects (such as neutronics, thermal-hydraulics, safety, etc.) and socio-economical aspects.
- Outcome 3. Students will demonstrate the ability to perform work in teams, prepare technical report, communicate (oral and written) and make presentations.

Course Requirements & Grading

Presentation I - Initial presentation

Each team will perform literature search to refine and better understand their task objectives, scope, state of art, and challenges. Also, identified/refined technical topics, individual responsibilities, and schedule will be presented.

Presentation II – Scoping studies, initial design

Each team will summarize further findings of their literature search, and present the results of initial trade-off studies to justify their initial selection of basic design parameters. Initial/scoping results will be presented.

Presentation III – Tentative final design

About 2-3 weeks before the final presentation, each team will give a detailed presentation about the current status of their design task and discuss their tentative final design.

Assignment	Date	Weight (Percentage, points, etc)
Form Teams, Define/assign design tasks	Week 1	
Presentation I - Initial presentation	Week 3	10% of total grade
Presentation II – Scoping studies, initial design	Week 8	15% of total grade
Presentation III – Tentative final design	Week 13	15% of total grade
Final report of design effort	Present Last Week of Classes Submit 4 days before	25% of total grade
36"x48" poster of their design effort	Present Last Week of Classes Submit 3 days before	10% of total grade
Final presentation	Present Last Week of Classes Submit 2 days before	15% of total grade
Participation at Expo	As announced	5% of total grade
Electronic Files	Within 3 days after the final presentation	5% of total grade
Peer evaluation, individual performance	Last week of classes	Adjusts grade by up to $\pm 20\%$

Description of Graded Components

Teams: Participants will be grouped into teams. Each team will focus on a specific design. Each team is responsible to plan their activities, make adequate progress, resolve technical challenges in a timely manner, and prepare and deliver all reports, presentations and deliverables by the due dates. Ultimately, it is each team's responsibility to successfully and timely complete the project. When appropriate, a team may be further subdivided into technical groups with specific responsibilities.

Performance of individual team members and peer review:

Team members have a responsibility to make sure all team members participate on an equal basis. Each team member should contribute to the best of their abilities. In case a team member is not contributing or fulfilling his responsibilities, other team members should promptly convene a whole-team meeting, point to the issue, discuss the situation in a factual and professional manner, and jointly seek solutions. Promptly and professionally addressing such situations tends to resolve the issue in a large majority of cases. If the problem persists, inform the instructor.

Peer-review within each design team: Each team member will grade his / her team mates on their contributions and cooperation over the semester. This information, together with other relevant information, will be used to differentiate between the individual team members grades.

Progress Reports Class meetings will also serve to report project progress. Each design team will give brief oral presentations/updates on the state of the design. Technical issues will be discussed.

Deliverables During the Semester: Presentation I - Initial presentation
Each team will perform literature search to refine and better understand their task objectives, scope, state of art, and challenges. Also, identified/refined technical topics, individual responsibilities, and schedule will be presented.

Presentation II – Scoping studies, initial design

Each team will summarize further findings of their literature search, and present the results of initial trade-off studies to justify their initial selection of basic design parameters. Initial/scoping results will be presented.

Presentation III – Tentative final design

About 2-3 weeks before the final presentation, each team will give a detailed presentation about the current status of their design task and discuss their tentative final design.

Final Deliverables:

Final deliverables:

- 1) Each team will prepare a written final report of their design effort. The final report should be prepared according to the template/specifications using Microsoft Word, and submitted as both the native Word file and PDF.
- 2) Each team will make a 36"x48" poster of their design effort, and submit a PPT and PDF electronic file of the poster. Posters will be presented in connection with the final presentation, and at the GT Capstone Design Expo. Each team is responsible for timely registering for the Expo, printing the poster, and participating.
- 3) Each team will make a final presentation. Final presentations will be held during the last week of classes (Monday/Tuesday). Backup time is during the final exam time associated with this class. Each team member is required to participate in the final presentation, and attend all other presentations. The presentation files will be submitted in advance in PPT and PDF format.
- 4) Within 72 hours after the final presentation, each team will submit all electronic files documenting their modeling and simulation efforts, i.e., input/output files and a document (briefly but clearly) describing the files. [Keep track and store during the semester!!]

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 should be anticipated for this course.

Course Materials

Course Text

Study materials will be provided in class and via T-square.

Additional Materials/Resources

1. J. Duderstadt and L.J. Hamilton, *Nuclear Reactor Analysis*, Wiley (1976)
2. W.M. Stacey, *Nuclear Reactor Physics*, (2nd ed.), John Wiley & Sons (2007)
3. N.E. Todreas, M.S. Kazimi, *Nuclear Systems I/II*, Taylor and Francis (2001); 2nd Ed. 2012 (reprints 2013, 2015; with Errata)
4. J.R. Lamarsh, *Introduction to Nuclear Engineering*, (2nd ed.) or J.R. Lamarsh and A.J. Baratta (3rd ed.), Prentice Hall (2001)
5. J.R. Lamarsh, *Introduction to Nuclear Reactor Theory*, Addison-Wesley (1966, 1972)
6. K.O. Ott and W.A. Bezella, *Introductory Nuclear Reactor Statics*, ANS (1989)
7. K.O. Ott and R.J. Neuhold, *Introductory Nuclear Reactor Dynamics*, ANS (1985)
8. G.I. Bell and S. Glasstone, *Nuclear Reactor Theory*, R. E. Krieger Publishing (1985)
9. A. Waltar, D. Todd, P. Tsvetkov, *Fast Spectrum Reactors*, Springer (2012) [electronic version available online at GT library]
10. H. Hummel and D. Okrent, *Reactivity Coefficients in Large Fast Reactors*, ANS (1978)
11. Y.S. Tang, R.D. Coffield, Jr, and R.A. Markley, *Thermal Analysis of Liquid Metal Fast Breeder Reactors*, ANS (1978)
12. J.K. Shultis and R.E. Faw, *Radiation Shielding*, ANS (2000)
13. MCNP Manual, latest version
14. SCALE Manual, latest version
15. RELAP Manual, latest version
16. Additional references will be provided as appropriate
17. Library resources to look up journal papers and citations.

Course Website and Other Classroom Management Tools

TSquare and 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/>, and <http://disabilityservices.gatech.edu/content/welcome-accommodate> 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 is mandatory during the first four weeks, all scheduled tutorials, Presentations I-II-III, all final events (including Expo), and all announced meetings. Team meetings attendance is mandatory for all team members. If you believe there is a reason for absence (other than Institute Approved Absence), notify the instructor sufficiently in advance with a detailed justification. This applies to absence at any time during the semester.

Collaboration & Group Work

Each Team is expected to independently perform all their assigned task. However, discussion among students on understanding of the common technology issues and global modelling and simulation challenges is allowed and 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

Presentations will not be rescheduled. Some exceptions for approved Institute activities” (e.g. field trips and athletic events) will be made based on appropriate paperwork provided by the student/team to the instructor, as soon as possible, and at least two weeks prior to the scheduled event or deadline, in order to schedule makeup work and/or adjust the schedule. Final deliverables and their schedule cannot be modified.

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

The materials used in this class, including, but not limited to, exams, quizzes, homework assignments, and lectures are copyright protected works. Any unauthorized copying of the class materials is a violation of federal law and may result in disciplinary actions being taken against the student. This includes, among other things, uploading class materials to websites for the purpose of sharing those materials with other current or future students.

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

Topics covered and references will be selected appropriate to the specific design project(s) — integrated design of a major nuclear or radiological facility, machine or equipment, or associated fuel cycle.

Date	Topic	Notes (Reading, Notes, due dates, and more)
Week 1-2	Literature review	Each team will perform literature search to refine and better understand their task objectives, scope, state of art, and challenges. Literature review will include research publications, and applicable standards and code
Week 3	Presentation I - Initial presentation	Each team will report on literature search to refine and better understand their task objectives, scope, state of art, and challenges. Also, identified/refined technical topics, individual responsibilities, and schedule will be presented.
Weeks 4-7	Scoping studies Progress report	Each team will perform further findings of their literature search, and perform initial trade-off studies to justify their initial selection of basic design parameters. Initial/scoping results will be presented.
Week 8	Presentation II – Scoping studies, initial design	Each team will summarize further findings of their scoping studies and initial design.
Weeks 9-11	Preliminary Design	Improve on scoping studies and converge towards preliminary final design.
Week 11 or 12	Presentation III – Preliminary design	About 3-4 weeks before the final presentation, each team will give a detailed presentation about the current status of their design task and discuss their tentative final design.
Weeks 12-14	Final Design	Further improve on design. Prepare and submit deliverables – report, poster, and presentation
Final Week 15	Final report, poster and presentation Capstone Expo Electronic Files Peer Evaluations	Each team will make a 36"x48" poster of their design effort and final presentation. Each team will submit all electronic files documenting their modeling and simulation efforts, i.e., input/output files and a document (briefly but clearly) describing the files.