1. Description

Nuclear reactor theory and engineering as applied to design synthesis of reactors. Nuclear, material, thermo-fluid, and/or mechanical design considerations of nuclear reactors with particular emphasis on design characteristics. Analytical methods and application of computer codes for design analysis and evaluation. Individual and/or group design involving integration of reactor neutronics, dynamics and control, thermal hydraulics, transient analysis and safety, power production, instrumentation, control, radiation shielding and protection, fuel cycle, fuel behavior, and/or cost based on realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

2. Pre-requisites

ENU 4104, ENU 4612, ENU 4630, ENU 4191, and ENU 4134. Co-req: ENU 4641

3. Course Objectives

1. Graduates will have successful careers in Nuclear Engineering or related disciplines.
2. Graduates will pursue advanced degrees or continuing education.

4. Professional Components Supported by Course

3 credits engineering, significant design content

1. Provide students with the ability to apply advanced mathematics, computational skills, science and engineering science, including atomic and nuclear physics, to identify, formulate, analyze, and solve nuclear and radiological engineering problems.

2. Provide students with the skills needed to communicate effectively, work collaboratively, and understand their professional and ethical responsibilities and the impact of engineering solutions in a societal and economic context so they can pursue successful, productive careers in nuclear and radiological engineering.

5. Program Outcomes Supported by Course

Outcome a: an ability to apply knowledge of mathematics, science, and engineering.

Outcome c: an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Outcome d: an ability to function on multi-disciplinary skills teams.

Outcome e: an ability to identify, formulate, and solve engineering problems.

Outcome f: an understanding of professional, ethical and regulatory responsibility in engineering practice.

Outcome g: an ability to communicate effectively, using both oral and written presentations, in engineering practice

Outcome h: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Outcome i: a recognition of the need for life-long learning and the ability to adapt this to engineering practice;

Outcome j: a knowledge of contemporary issues as they relate to professional engineering practice

Outcome k: an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Outcome l: an ability to apply advanced mathematics, science, and engineering sciences, including atomic and nuclear physics, to nuclear and radiological systems and processes

Outcome n: an ability to work professionally in on or more of the areas of: nuclear power systems, nuclear instrumentation and measurement, radiation protection and shielding, and radiation sources and applications

6. Instructor

Lead: Sedat Goluoglu, Professor
168 Rhines
352-294-1690
goluoglu@ufl.edu
Office hours: TBD
Course website: on ELearning/Sakai platform.

Assisted By:

• *All NE faculty*

7. Teaching Assistant

None

8/9/10. Course Meetings

NSC 227 or conference room(s) TBD, MW 1500-1615 (UF "Periods" 8-9). Final presentation location: TBD

11. Material and Supply Fees

None

12. Text (Required)

None

13. References

Fundamental of Engineering (FE) Supplied Reference Handbook:
http://www.ncees.org/exams/study_materials/fe_handbook/index.php

1. Handbook of Nuclear Reactors Calculations, Vol. I, Ed. Y. Ronen, CRC Press, 1986.
2. A Guide to Nuclear Power Technology, F.J. Rahn, *et al.*, J. Wiley & Sons, 1984.
3. Structural Materials in Nuclear Power Systems, J.T.A. Roberts, Plenum Press, 1981.
4. Principles of Design Improvement for Light Water Reactors, L.S. Tong, Hemisphere Publishing,

1988.

5. Thermal Design of Nuclear Reactors, R.H.S. Winterton, Pergamon Press, 1981.
6. Nuclear Power Plant Design Analysis, Alexander Sesonske, NTIS TID 26241, 1973.
7. Nuclear Reactor Analysis, J.J. Duderstadt & L.J. Hamilton, J. Wiley & Sons, 1976.
8. Nuclear Systems I & II, N.E. Todreas & M.S. Kazimi, HPC, 1990.
9. Heat Transfer and Fluid Flow in Nuclear Systems, Henri Fenech, Pergamon Press Inc, 1981, ISBN 0-08-027 181-2.
10. Nuclear Power Plant Engineering, James H. Rust, Haralson Publishing Company, 1979, ISBN 0-934534-00-4.
11. Nuclear Heat Transport, M.M. El-Wakil, Intl Textbook Co (and ANS), 1971, ISBN 0-7002-2309-6.
12. Nuclear Power Plants' FSARs
13. Nuclear Fuel Cycle: Analysis and Management, Robert Cochran and N. Tsoulfanadis, 1993.
14. Nuclear Power Reactor Instrumentation Systems Handbook, Vol. I & II, J. M. Harrer and G.Beckerely, USAEC, 1973.
15. PE Review Manual
16. Nuclear Reactor Kinetics, 2nd Edition, M.S. Ash, 1979.
17. Radiation Detection and Measurement, 2nd Edition, G. F. Knoll, 1979.
18. Radiation Shielding, J. K. Shultis and R. E. Faw, 2000.
19. Nuclear Reactor Theory, Bell and Glasstone, VanNostrand Reinhold Company, New York, 1970.

14. Course Outline (Schedule)

The class starts at 3:00PM. Each group (and each group member) will provide status update and is expected to be present during the entire class.

Each group will prepare an Interim Design Report (due around middle of semester – exact date TBD) and prepare a presentation based on the information on the IDR. Each group will also prepare a Final Design Analysis Report (FDAR) (due at the end of the semester prior to final presentations – exact date TBD) and prepare a presentation based on the information on that report. In addition there will be two Interim Progress Presentations (IPP) on design status: one approximately mid-point between the start of the semester and the due date for the IDR and the second around the mid-point between IDR and the end of semester. Exact dates will be announced at least two weeks prior to due date.

Turn-in requirements for the IDR and FDAR will be included on the corresponding assignment documents. Each will be due along with a separate individual self-assessment.

15. Attendance and Expectations

This course is far more similar to a design group at a reactor vendor than to any other ENU course. In most courses, instructors spend considerable effort to organize the material for your rapid consumption, but in ENU 4192 *you will not be led step-by-step* through the design project. It is *your job* to formulate design questions, *your job* to break them into manageable chunks, *your job* to acquire and use the tools needed to do the analysis, and *your job* to communicate the results and/or ask for assistance when necessary.

Attendance

You are expected to attend all meetings and presentations, barring meritorious professional or University-sanctioned personal reasons. Particularly meritorious reasons are expected for any absence from presentations. If you are absent from class without justification, this will affect your grade. Whether or not your justification for your absence is acceptable (other than those that are sanctioned by the University) is at sole discretion of the Lead Instructor. Notify the Lead Instructor and check to see if it is acceptable as soon as you know you will be absent. As a hint, "I partied too much and have a hangover" will not pass the muster. If you miss a presentation without being excused, you will receive no credit for that presentation (but can receive credit for the corresponding document if there is one).

No electronic disruptions are tolerated in class. Those responsible for the disruption will be ejected from the classroom, not allowed to return on that day, and considered to be absent for that period.

Late Work

Late written reports lose 20% per day (*calendar* day, not working day; rounded up – one hour late is a day late; onus is on *you* to provide to instructor). No late presentations allowed.

Report/Discussion Parameters

IPP

- 25 minutes per group for presentation, 5 minutes between groups set-up/buffer time, first group ready to go at 1500.

IDR

A more detailed assignment will be provided for the IDR closer to the deadline.

- 40 minutes per group for presentation, 5 minutes between groups set-up/buffer time.
- Expectations: a document of approximately 40 pages (plus appendices), targeted for external use (*i.e.*, reactor vendor design team giving first description to NRC and possible purchasers), covers all progress since beginning of course, covers all technical areas. This is a significant, formal report and deserves serious effort. Absolutely no material should appear on slides that is not in report.
- Turn in requirements included in detailed assignment.
- Will be recorded for ABET and future NEP use.

FDAR

A more detailed assignment will be provided for the FDAR closer to the deadline.

- approximately 1 hour per group; details TBD.
- Expectations: a document of approximately 75 pages (plus appendices), targeted for external use (*i.e.*, reactor vendor design team giving report to NRC and possible purchasers), covers all progress since beginning of course, covers all technical areas. This is a significant, formal report and deserves serious effort. Absolutely no material should appear on slides that is not in report.
- Turn in requirements included in detailed assignment.

• Will be recorded for ABET and future NEP use.

Informal Discussion

- meetings with each group, location TBD.
- Expectations: this is a weekly, informal meeting with your supervisor(s) to discuss your progress, goals/activities for the next week, and get advice. You should not prepare anything special for these meetings, but should bring laptops or printouts to discuss what you've done and what you will do in the next week.
- Not recorded, no deliverables unless requested by instructor.

Feedback

You will receive feedback live at all of the above meetings and in written form for everything you turn in.

It is vital that you respond to feedback by improving your work *promptly*. Do not wait for the grade to come in before responding to the live feedback in the presentation and any early written feedback. Generally, you should have made progress by the next week's informal discussion. Issues brought up in one presentation that are not addressed by the next will lead to *major* reductions in your technical quality score and in the professionalism evaluation of the members responsible for that area.

Consider: if you were working in a real reactor vendor design group, would your supervisor tolerate a 3-4 week turnaround time for response?

Recommendation Letters

Your first request for recommendation letters for graduate school, internships, and the like must include appropriate release letter (check with academic advising office).

16. Grading

- IPP: 2x100 points (group)
- IDR: 200 points (group and individual components)
- FDAR: 400 points (group and individual components)
- Self-assessments – 2x50 (individual)
- Attendance – 100 (individual; will get 0 if more than 2 unexcused absences)
- Individual Adjustments: see below

Total: 1000 points

The breakdown of IPP grades can be found on the IPP Guide on the website. Separate assignments clarifying expectations for the IDR and FDAR (including adjoining self-assessments) will be sent 2-3 weeks prior to their respective due dates.

The individual evaluation includes quantity and quality of work, diligence in meeting deadlines, and professionalism for the course. Peer evaluations will be required prior to the IDR and FDAR; adjustments are based in part on these evaluations. You will be informed of your individual adjustment. A student meeting expectations will receive a grade of 0 (no adjustment). Strong performers will receive a bonus; weak links a penalty. These individual adjustments are considered part of your individual IDR and FDAR grades.

Each year, ANS has a design competition to which only one group per program may submit. Assuming that the report is of respectable quality, the group with the highest FDAR score will be invited to submit their work. Runner(s)-up will be invited if their work is also of respectable quality and the first-place group declines the invitation.

17. Grading Scale

If you do not earn at least 675 points (out of 1000) in the course *and* 275 (out of 400) on the FDAR, you will receive a grade of E. The 275 FDAR threshold is applied to each student's grade, including individual adjustments (if any).

If you meet or exceed those limits, but do not completely meet the turn-in requirements for the FDAR, you will receive a grade of I (incomplete)

For those who meet the minimum pass standard and the FDAR turn-in requirements, the final grading scale will be no harsher than:

A: 850+
B: 775-849
C: 675-774

The lead instructor reserves the right to:

1. Round assignment grades to full points.
2. Grant grades more generous than these guarantees, including +/- grades.
3. Adjust co-instructor evaluations by adding or subtracting a constant from all scores, to conform to lead instructor evaluations. If such an adjustment would have an absolute value of strictly less than five points, no adjustment will be made.

This statement must be included in every grade scale for undergraduate level 1000-5000 syllabi:

"A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit: https://catalog.ufl.edu/ugrad/current/Pages/academic-regulations.aspx"

18. Make-up Exam Policy

No exams means no make-up exams. No make-up presentations allowed.

19. Honesty Policy – UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Note that failure to comply with this commitment will result in disciplinary action compliant with the UF

Student Honor Code Procedures.
See http://www.dso.ufl.edu/sccr/procedures/honorcode.php

20. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. UF Counseling Services –Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

· UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, http://www.counseling.ufl.edu/cwc/Default.aspx, counseling services and mental health services.

· Career Resource Center, Reitz Union, 392-1601, career and job search services.

University Police Department 392-1111

22. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

23. Students are expected to provide feedback on the quality of instruction in this course based on 10 criteria. These evaluations are conducted online at https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results.