

Changes to this syllabus will be provided via the ELearning/Sakai platform. Such changes may include those required by policy changes, instructor travel, changes in the speed of course coverage, university closure, errors in previous syllabus versions, and other reasons.

1. Description

Advanced light-water reactors, gas-cooled reactors, liquid-metal reactors. Thermal modeling, reactor safety, licensing, reactor physics, materials selection, and fuel cycles.

2. Pre-requisites

(ENU 4134 or ENU 6135) and (ENU 4103 or ENU 6106)

ENU 6135 is the planned future code for the ENU 6937 attached to ENU 4134.

3. Course Objectives

1. Provide students with an understanding of advances in light-water reactor (LWR) technology seen in Generation III (Year 2000 and beyond) systems and the ability to discuss and analyze the improvements to reactor safety in these systems
2. Provide students with an understanding of relevant phenomena (thermal, material, neutronic) for novel reactor systems (gas-cooled reactors, liquid-metal reactors, etc.) to make relevant comparisons both among these novel concepts and with existing LWR systems
3. Prepare students to undertake research in the areas of advanced nuclear fission reactor design

4. Contribution of Course to Meeting the Professional Component

n/a, graduate course

5. Relationship of course to program outcomes

n/a, graduate course

6. Instructor

DuWayne Schubring, Assistant Professor

205 Nuclear Science Building

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Office hours: TBD (during first class session), via e-mail, or appointment.

Course website: ELearning/Sakai platform.

7. Teaching Assistant

None

8/9/10 Course Meetings

MWF, 1355-1445 (UF “Period” 7), NSC 227.

11. Material and Supply Fees

None

12. Text (Required)

None. Notes to be provided.

13. References

Nuclear Systems I: Thermal Hydraulic Fundamentals, N.E. Todreas and M.S. Kazimi, 1990 (1st edition). (ISBN: 1560320516)

Nuclear Systems I: Thermal Hydraulic Fundamentals, N.E. Todreas and M.S. Kazimi, 2011 (2nd edition). (ISBN: 9781439808870)

Nuclear Heat Transport, M. M. El-Wakil, 1978 (1st edition). (ISBN: 0894480146).

Nuclear Energy Conversion, M. M. El-Wakil, 1982 (Revised Edition). (ISBN: 0894480154).

Nuclear Reactor Analysis, J. J. Duderstadt and L. J. Hamilton, 1976. (ISBN: 0471223638).

References from recent literature will be provided electronically.

14. Course Outline (Schedule)

The following 10 topics will be covered in the class by a module 1-2 weeks in length:

- Generation III BWRs
- Generation III PWRs
- Supercritical Water Reactors
- Gas-cooled (Thermal) Reactors – Materials Selection and Development
- GCRs – Core Layout (Pebble Bed, Prismatic) & Reactor Physics
- GCRs – Core and Balance of Plant Thermal Analysis
- Sodium Cooled (Fast) Reactors – Materials Selection and Development
- SCRs – Reactor Core Layout & Reactor Physics
- SCRs – Reactor Thermal Analysis
- Lead, LBE, and Gas-cooled Fast Reactors

Each module will each have a project attached, usually due during the following module. These projects are of intermediate length, complexity, and open-ended-ness between ENU 413x HW and Projects. Some projects may require access to export-controlled software. Appropriate accommodations, which may include restrictions on your choice of which project(s) to drop, will be made.

ENU 6937: You must complete 9 of these 10 projects. (You may not do all and drop the lowest.) Your 10th project is a review of a paper on nuclear thermal hydraulics, to be presented to the class. Detailed literature review instructions will be provided in a separate document.

15. Attendance and Expectations

Attendance & Class Conduct

Skip at your peril. Attendance is not considered in the grade. However, some materials in the course will not be covered in the textbook or in the notes provided online – only in class. Some example problems and complex figures (hard to digitize, easy to make on chalkboard) fall into this category. Students are responsible for these materials.

If a student arrives late or leaves early, he/she is expected to do so with minimum level of disruption to the class in progress. There is no tolerance for mobile phones or other electronic disruptions. Such disruptions will lead to the student being told to leave the room for the duration of the class period. The same principle applies to office hours or appointments – if you stop by my office and your phone rings, you will be told to leave the room for the duration of that day's office hours (or your appointment considered over).

Projects

Electronic submission of project narratives is not accepted. Electronic submission of files used on projects (spreadsheets, etc.) may be required for some projects, as indicated on the assignment sheet. Submissions *must* be in the formats requested. If you do not know how to convert your files to these formats, contact the instructor in advance of the deadline. Not knowing your software is not an excuse for late projects!

The allowable level of collaboration on projects may vary throughout the course and is indicated clearly on each assignment. On group projects, you will need to collaborate with and divide labor among the members of your team, but no collaboration among teams is permitted. Late projects will lose 10% of their value each calendar day, rounded up (so 3 hours late is considered 1 day late). Any project strictly more than 3 calendar days late will have no value. If your project is late, the onus is on you to provide it to me; *the clock does not stop until I have project in hand.*

Certain professional document and figure standards will be enforced on project narratives; *the onus is on you to figure out how to meet these standards in whatever programs you use to write the document and make figures.* Your instructor has little sympathy for those who select a word processor without knowing how to format their text using it – complaints that the standards are not the same as a particular piece of software's defaults will fall on deaf ears.

Make-Up Work Policies

Reasonable extensions for job/internship interviews and technical conferences should be requested. The instructor routinely makes accommodations for these professional development activities, well beyond what is demanded by UF policies.

Extensions will also be granted for medical reasons, subject to the instructor's discretion to require documentation as allowed by UF policies.

In addition, UF policies require accommodation for several non-academic, non-medical reasons. *Extensions for these personal issues are strictly limited to those mandated by the letter of UF policies.* UF-authorized extensions include UAA competitions, religious observances, and serious illness or death of specified relatives. If you have a question regarding your personal issue and if it qualifies under one of the excused absence policies, contact the instructor in advance.

File Formats

The electronic components of project submissions *must* be in the formats requested. If you do not know how to convert your files to these formats, contact the instructor in advance of the deadline. Not knowing your software is not an excuse for late projects. Acceptable formats may include plain text, .pdf, .csv, .xls, and EES files, as well as other file formats at the instructor's discretion.

In particular, the instructor will not open files from students in the following formats: .xlsx, .ppt, .pptx, .doc, .docx. Presentation and word processing documents are best converted to .pdf. Spreadsheets can be converted to .xls or .csv.

E-mail

The primary means of communication with the class outside of class time will be e-mail listserv. These listservs will send to your @ufl.edu address only. Any inquiries regarding grading will be directed towards your @ufl.edu address only, per FERPA compliance regulations.

Technical and procedural questions will be answered as a reply to whatever e-mail address you used to send them. If the entire class will benefit from the answer, I may send to the class list (either in lieu of or in addition to a direct reply to you, at my discretion). If you do not wish to have a specific e-mail to me regarding technical content or course procedures replied to through the class list, you must explicitly state this in that e-mail. In such a case, I will reply directly to you and send a general-purpose announcement to the class list, not indicating who caused me to send it.

Letters of Recommendation/Evaluation Policy

To request a letter of recommendation/evaluation (for graduate school or otherwise), you must provide:

- A hard copy of your UF transcript.
- A hard copy of a résumé (or CV).
- A hard copy of the following form: <http://www.registrar.ufl.edu/pdf/ferparelease.pdf>. You *must* check all four circles.

Letters are typically filed once per week. For students whom I know only through coursework, my letter typically focuses on an estimate of their rank-in-class and on their performance on projects and challenging problems.

I will only file *one batch* of letters per student during the term, for any student currently enrolled in a class with me. (This policy is designed to keep me from looking up slight changes in your rank/performance multiple times for multiple batches of letters.)

Grade Appeal

Grade appeals are normally entertained for one week after a project is returned to you. This may be modified for specific projects via e-mail message to the class list. To prevent incessant, frivolous appeals, please note that after 2 unsuccessful grade appeals, you forfeit your right to appeal *any* grades for the remainder of the term.

16/17. Grading

Your course grade is based on the average of your 10 project grades. There is no final.

Components of the projects with exactly one correct solution will be graded between 0 and 4; open-ended components (writing, professionalism, design, optimization, analysis, etc.) will be graded to a maximum of 5. As a result, grades above 4.0 will be awarded for genuinely exceptional work. Project grades of 1.75 and above can be roughly interpreted on the GPA scale.

- A: 3.6 +
- A-: 3.5-3.59
- B+: 3.4-3.49
- B: 2.5-3.39
- C: 1.75-2.49
- E: 0-1.74

The instructor reserves the right to grant grades more generous than this scale at discretion at the end of the course, including B- or C+. *Under no circumstances will grades of C- or any flavor of D be used.*

The instructor reserves the right to cancel the project for the 10th module, in the case of slowdowns in class coverage or cancelled class sessions. In this case, your grade would be based on the average of 9 projects.

COE required statement: “Graduate students need an overall GPA of 3.00 truncated and a 3.00 truncated GPA in their major (and in the minor, if a minor is declared) at graduation. For more information on grades and grading policies, please visit:

<http://gradcatalog.ufl.edu/content.php?catoid=4&navoid=907#grades>

18. Make-up Work Policy

Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

These requirements are detailed in Item 15.

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. Course Evaluations

The University of Florida expects students 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>