Reactor Analysis and Computation I
ENU 4103 Section 2B30
Class Periods: MW, Periods 3&4, 9:35-11:30 AM
Location: Turlington Hall, Room 2349
Academic Term: Spring 2026

Instructor:
James E. Baciak
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352-273-2131
Office Hours: Monday, Period 8-9 :3:00 - 4:55 PM
Tuesday, Period 8-9: 3:00 - 4:55 PM
Friday, Period 5-6: 11:45 AM – 12:35 PM (Zoom only)

109 Nuclear Annex Building

Note: These times are subject to change during the first week of class to better accommodate schedules. In addition, Friday's office hour will be a Zoom hour to better assist students that may be prefer asking questions virtually (plus I will have travel that I need to accommodate for the Consortium for Nuclear Forensics and I will be backloading my travel to Thursdays and Fridays on many weeks).

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

None at this time.

Course Description

Lectures discussing neutron reactions, fission chain and criticality and neutron transport/diffusion for nuclear reactors. Neutron thermalization and thermal scattering kernals. Dynamic analysis of reactors including point and space-time models. Feedback and reactor dynamics and control. Short-term transient analysis and long-term time-dependence.

Course Pre-Requisites / Co-Requisites

ENU 4003 and ENU 4605 with minimum grades of C.

Course Objectives

1. Students will develop a familiarity with basic topics in atomic and nuclear physics, interactions of radiation with matter, and neutron energy distributions. Classical reactor physics and their application to simplified reactor geometries (HW 1-2, Exam 1, Final Exam).
2. Students will develop a familiarity with basic neutronics characteristics of both traditional light water reactors and non-light water reactors (HW 3, Exam 2, Final Exam).
3. Students will develop a familiarity with basic topics in classical reactor physics and their application to simplified reactor geometries, including time dependent behavior (HW 4-7, Exam 2, Final Exam).
4. Students will learn modern computer programming techniques for solving classical reactor physics problems, including Monte Carlo methods (Project).
5. Students will demonstrate proficiency in solving reactor physics problems using modern computer programming techniques (HW 6).
6. Students will demonstrate an ability to document computer model development and numerical analysis, including any assumptions or approximations necessary to address the problem statement (Project).

Materials and Supply Fees

None.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Medium
3. An ability to communicate effectively with a range of audiences	Low
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Low
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software

- Introduction to Nuclear Engineering, Fourth Edition
- John R. Lamarsh and Anthony J. Baratta
- 2018
- 0134570057

Note: Some course notes materials a derived by the instructor, particularly those on Modeling methods. OpenMC materials derived off of the OpenMC website (https://docs.openmc.org/en/stable/usersguide/beginners.html)

Recommended Materials

- James J. Duderstadt and Louis J. Hamilton, "Nuclear Reactor Analysis," 1976, 0-471-22363-8
- Weston M. Stacey, "Nuclear Reactor Physics," 2018, Third Revised Edition, 978-527-41366-9

Required Computer

Recommended Computer Specifications: https://it.ufl.edu/get-help/student-computer-recommendations/

HWCOE Computer Requirements: https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/

For this course, you will need to have access to OpenMC. OpenMC is a community-developed Monte Carlo neutron and photon transport code. It is capable of performing fixed source, k-eigenvalue, and subcritical multiplication calculations on models built using either a constructive solid geometry or CAD representation. The software and additional information can be found at https://openmc.org/.

Course Schedule

Date		Course Topic
January	12	Introduction, Course Goals and Objectives, Atomic and Nuclear Physics
	14	Atomic and Nuclear Physics
	19	**No Class – MLK Day**
	21	Atomic and Nuclear Physics; Neutron Interactions with Matter
	26	Neutron Interactions with Matter
	28	Neutron Interactions with Matter
February	2	Neutron Energy Distributions
	4	Neutron Energy Distributions
	9	Nuclear Power and Power Reactors
	11	Nuclear Fission Process
	16	**In-Class Test #1**
	18	Proper Plotting and Figure Formats for Scientific and Engineering Reports; Introduction to the Group Project
	23	Introduction to Monte Carlo Theory and Finite Difference Methods
	25	Introduction to OpenMC
March	2	Introduction to Neutron Transport and Diffusion Theory
	4	Introduction to the Neutron Transport Equation
	9	Introduction to the Neutron Transport Equation
	11	Multigroup Neutron Diffusion Theory
	16	**No Class – Spring Break**
	18	**No Class – Spring Break**
	23	Multigroup Neutron Diffusion Theory
	25	Criticality Calculations and Problems
	30	**In-Class Test #2 (Can also be Take Home)**
April	1	Group Project Day – No Formal Class
	6	Neutron Diffusion Theory in Homogeneous Multiplying Media
	8	Neutron Diffusion Theory in Homogeneous Multiplying Media
	13	Heterogeneous Reactors
	15	Heterogeneous Reactors and Homogenization
	20	Time Dependent Reactor Kinetics
	22	Time Dependent Reactor Kinetics; Class Review
	27	
	29	**FINAL EXAM (3:00-5:00 PM)**
	30	

Important Dates

February 16 *Test #1 (Periods 3 & 4, during normal class)*
March 30 *Test #2 (Periods 3 & 4, but could also be a take home exam)Project 1 Due (Time)*
April 17 *Final Project Report Due*
April 29 *Final Exam (3-5 PM, in normal classroom)*

Attendance Policy, Class Expectations, and Make-Up Policy

Students are expected to attend each class period. Periods which may be missed should be brought to the attention of the Instructor as far in advance of the class period as possible. In the event of an unexcused absence, it is the student's responsibility to obtain and review the material that was covered during that class period.

Late-work excuses can be grouped into the categories of professional, medical, and personal.

Professional: Reasonable extensions for job/internship interviews, technical conferences, or other professional/career development reasons should be requested. Requests are typically granted, at my discretion, unless they would grant a student or group of students an unfair advantage over their peers, cause significant disruption to the course or grading schedule, or violate some UF policy.

Medical: Extensions will also be granted for (your own) medical reasons – please do not come to class if you are ill. Per UF policy, in the case of medical absences that are frequent or suspiciously- timed (e.g.; you are repeatedly, suddenly ill at deadlines), I may request a signed note from a physician or similar professional practitioner.

Personal: 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. The list of UF-approved personal reasons changes from time to time. If you have a question regarding your personal issue and if it qualifies under one of the excused absence/late-work policies, contact me in advance.

The 12-day rule will be enforced strictly. Note that the count of days is based on a per-student, not per-approved-activity basis. All requests for excused absence or extension must be submitted in writing, preferably via e-mail.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Evaluation of Grades

Assignment	**Total Points**	**Percentage of Final Grade**
Homework Sets (8-10)	Varies	30%
Quizzes	10	5%
Tests	100	25%
Final Exam	100	20%
Project Report	100	20%
Total		**100%**

Grading Policy

Percent	**Grade**	**Grade Points**
93.0 - 100	A	4.00
89.0 - 92.9	A-	3.67
85.0 - 88.9	B+	3.33
82.0 – 84.9	B	3.00
79.0 - 81.9	B-	2.67
76.0 - 78.9	C+	2.33
72.0 - 75.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
62.0 - 65.9	D	1.00
59.0 - 61.9	D-	0.67
0 - 58.9	E	0.00

Since I do not curve the grading scale, all students can receive an A (or an E)! Note: this scale may be adjusted from semester-to-semester by a couple of points depending on topics covered and difficulty of exams.

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Academic Policies & Resources
Please see this link to academic policies and campus resources available to students:
https://go.ufl.edu/syllabuspolicies.

Commitment to a Positive Learning Environment
The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

If you feel like your performance in class is being impacted, please contact your instructor or any of the following:
- Your academic advisor or Undergraduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu

Software Use
All faculty, staff, and students 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.

Student Privacy
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html