Reactor Analysis I

ENU 6106 Section NRA1
Class Periods: M,W,F, Period 5, 11:45 am – 12:35 pm
Location: FLI 0121
Academic Term: Spring 2026

Instructor:
Justin Watson
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(352) 273-0241
Office Hours: M, 3:00 pm – 5:00 pm or by appointment

Teaching Assistant/Peer Mentor/Supervised Teaching Student:
None

Course Description
(Official catalog version) Neutron reactions, fission and criticality for nuclear reactors. Analytical and numerical calculations for reactor design and analysis.

Course Pre-Requisites / Co-Requisites
None

Course Objectives

1. Students will develop a familiarity with basic methods and assumptions for reduction of the neutron transport equation to the diffusion approximation including multigroup diffusion (HW 1-2, HW 4-5, Exam 1 & 2, Final Exam).
2. Students will develop a familiarity with basic topics in nuclear reactor kinetics and dynamics (HW 3-4, Exam 2, Final Exam).
3. Students will develop a familiarity with fast and thermal spectrum calculations and cell calculations for heterogeneous core latices (HW 6-7, Exam 2, Final Exam).
4. Students will learn modern computer programming techniques for solving eigenvalue problems for Monte Carlo and finite difference methods (Project, Final Exam).
5. Students will demonstrate proficiency in solving reactor physics problems using modern computer programming techniques (Project).
6. Students will demonstrate an ability to document computer code development and numerical analysis, including any assumptions or approximations necessary to address the problem statement (Project).

Materials and Supply Fees
None

Required Textbooks and Software
- Nuclear Reactor Analysis
- James J. Duderstadt and Louis J. Hamilton
- 1976
- 0-471-22363-8

Recommended Materials
- Nuclear Reactor Physics
- Weston M. Stacey
- 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/

Course Schedule
Week 1: Syllabus, Differential Scattering Cross Sections, Kinematics of Neutron Scattering / Chapter 2
Week 2: Nuclear Motion, Neutron Transport Equation / Chapter 2 / Homework 1
Week 3: The Diffusion Approximation, Project Overview, Input Processing and Program Structure / Chapter 3, 4
Week 4: Monte Carlo Solution Methodology, One-Speed Diffusion Equation / Chapter 5 / Homework 2
Week 5: Initial and Boundary Conditions, Diffusion Equation Solution and Criticality /Chapter 5 / Exam 1
Week 6: Diffusion Equation Solution (Examples), Finite Difference Equations / Chapter 5 / Homework 3
Week 7: Numerical Methods, Reflected, Criticality, and Multigroup Diffusion / Chapter 7 / Project Part 1
Week 8: Multigroup Neutron Diffusion Theory / Chapter 7 / Homework 4
Week 9: Multigroup Neutron Diffusion (Work in Class), Multigroup Finite Difference, Two-Group Diffusion Equation / Chapter 7
Week 10: Two-Region Problem, Nuclear Power and Nuclear Reactors / Chapter 7 / Exam 2
Week 11: Energy Collapsing, Homogenization / Project Part 2
Week 12: Neutron Slowing Down Theory, Point Reactor Kinetics Equations / Chapter 8, 6
Week 13: Point Reactor Kinetics Equations / Chapter 6/ Homework 5
Week 14: Point Reactor Kinetics Equations, Kinetics Parameter Determination / Chapter 6
Week 15: Reactivity Feedback / Chapter 6 / Homework 6

Important Dates
2/9/2026 Exam 1 (11:45 am – 12:35 pm, FLI 0121)
2/25/2026 Project 1 Due
3/23/2026 Exam 2 (11:45 am – 12:35 pm, FLI 0121)
4/1/2026 Project 2 Due
4/29/2026 Final Exam (10:00 am – 12:00 pm, FLI0121)

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (6)	150	30%
Midterm Exam 1	50	10%
Midterm Exam 2	50	10%
Final Exam	50	10%
Project	200	40%
		100%

Grading Policy

Percent	Grade	Grade Points
92.0 - 100	A	4.00
88.0 – 91.9	A-	3.67
84.0 - 87.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 – 80.9	B-	2.67
76.0 - 77.9	C+	2.33

73.0 – 75.9	C	2.00
70.0 – 72.9	C-	1.67
66.0 - 69.9	D+	1.33
63.0 – 65.9	D	1.00
60.0 – 62.9	D-	0.67
0 - 59.9	E	0.00

Homework handed in up to 12 hours late will receive 30% off, homework handed in up to 24 hours late will receive 50% off. No homework will be accepted after 24 hours.

Requests for re-grading of any course document should be submitted as a written request within one week of the graded document being returned. After one week, re-grading requests will no longer be considered.

Academic Policies & Resources
To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: https://go.ufl.edu/syllabuspolicies. Instructor-specific guidelines for courses must accommodate these policies. **Graduate Level Attendance and Grading Policies:** https://gradcatalog.ufl.edu/graduate/regulations/

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 by discrimination or harassment of any kind, please contact your instructor or any of the following:
• Your academic advisor or Graduate 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