

ENU 5005 – Introduction to Nuclear Engineering

4 credits Fall 2025

Instructor: Kyle C. Hartig, Ph.D.

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Office: 210 MAE

Office Hours: TBD & by appointment (Virtual by Teams request)

Class: MW 09:35–11:30 (UF Periods 3–4), FLG 0275

Final Exam: Dec 10, 10:00–12:00 (Room TBD)

1 Course Description

Students will learn atomic and nuclear physics; interaction of radiation with matter; detecting nuclear radiation; neutron diffusion and moderation; nuclear reactor theory (steady and time-dependent); and two-phase flow and heat transfer at a level appropriate to begin graduate-level coursework in nuclear engineering sciences.

2 Course Prerequisites

Graduate Student Status.

3 Course Objectives

By the end of the course students will be able to:

- Demonstrate familiarity with atomic and nuclear physics.
- Explain basic radiation–matter interactions.
- Describe fundamental principles of radiation detection.
- Analyze neutron diffusion and moderation.
- Apply one-group and multi-group reactor theory.
- Model time-dependent reactor kinetics.
- Understand two-phase flow and heat transfer fundamentals.

4 Recommended Textbook

None.

5 References

1. James E. Turner, *Atoms, Radiation and Radiation Protection*, 3rd ed. (Wiley, 2007).
Free PDF: <https://onlinelibrary.wiley.com/doi/book/10.1002/9783527616978>
2. J. Kenneth Shultis & Richard E. Faw, *Fundamentals of Nuclear Engineering*, 3rd ed. (2016).
3. Glenn Knoll, *Radiation Detection and Measurement*, 4th ed. (2010).
4. John R. Lamarsh & Anthony J. Baratta, *Introduction to Nuclear Engineering*, 4th ed. (2018).
5. N. E. Todreas & M. S. Kazimi, *Nuclear Systems I: Thermal Hydraulic Fundamentals*, 2nd ed. (2011).

6 Lecture Schedule*

Modules:

Module 1: Atomic and nuclear physics
 Module 2: Interaction of radiation with matter
 Module 3: Radiation detection
 Module 4: Nuclear power reactors
 Module 5: Neutron diffusion and moderation
 Module 6: Nuclear reactor theory
 Module 7: Time dependent reactor theory
 Module 8: Two phase flow and heat transfer

Date	Mod.	Modality	Due	(Lecture #) Topic
Aug 25	1	Virtual		(1) Introduction to course & fundamental material
Aug 27	1	Recorded		(2) Radiation, radioactive decay, kinetics, units
Sep 1	1			Holiday (no class)
Sep 3	2			(3) Binding energy, nuclear equations (Q-values)
Sep 8	2		HW 1	(4) Radioactive series decay and equilibrium
Sep 10	2			(5) Photon interactions
Sep 15	2	Recorded		(6) Heavy charged particles and electrons
Sep 17	2			(7) Neutron interactions, radiation dose, KERMA, fission
Sep 22	3		HW 2	(8) Counting statistics
Sep 24	3			(9) General detector properties
Sep 29	3		Exam 1	Exam 1 (In-class)
Oct 1	3			(10) Gas detectors
Oct 8	3			(11) Scintillation detectors
Oct 13	3			(12) Semiconductor & neutron detectors
Oct 15	4		HW 3	(13) Nuclear power reactors
Oct 20	4	Recorded		(14) Neutron interactions (more info) and criticality
Oct 22	4		Exam 2	Exam 2 (In-class) Proctored
Oct 27	5	Indep. Work		(15) Diffusion equation
Oct 28	5		HW 4	(16) Solving the diffusion equation
Nov 3	6			(17) One-group reactor equation, slab reactor
Nov 5	6			(18) Reflected reactors, one-group critical, multi-group calculations
Nov 10	7	Virtual	HW 5	(19) Classification of time problems, reactor kinetics
Nov 12	7	Virtual		(20) Exam 3 Preview
Nov 17	7		Exam 3	Exam 3 (In-class)
Nov 19	7		HW 6	(21) Control rods, chemical shim, homogeneous reactors
Nov 24				Thanksgiving Holiday (No Class)
Nov 26			HW 7	Thanksgiving Holiday (No Class)
Dec 1	8			(22) Thermal hydraulics
Dec 3				(23) Course review
Dec 10				Final Exam

*Subject to change at the discretion of the instructor.

7 Grading

Total: 1000 points

- (7) Homework Assignments: 238 points (34 each)
- (3) Exams: 540 points (180 each)
- (1) Final Exam 222 points

Grade scale:

- A: 870+ points
- A-: 850–869 points
- B+: 830–849 points
- B: 750–829 points
- C: 660–749 points
- E: < 660 points

See UF policy in section 9 Standardized Syllabus Content.

8 Academic Policies & Resources

8.1 Assignments

All homework must be submitted as a single PDF via Canvas.

- Use a physical scanner or the free Adobe Scan app for handwritten work (no other scanning application is allowed).
- Electronic alternatives (Word+Equation Editor or L^AT_EX) are acceptable.

Late penalties:

- ≤ 24 h late: -25% (unless excused).
- > 24 h late: 0 points (unless excused).

8.2 Electronic Communication & Course Website

Canvas is used for syllabus updates, grades, announcements, and materials. Microsoft Teams is used for announcements and student–instructor chat.

8.3 Changes to Syllabus

Any changes will be posted on Canvas and announced in class. A new version of this syllabus will be published and an entry to the changelog will be made.

9 Standardized Syllabus Content

Verbatim language from University Syllabus Policies: “*Overarching academic policies and 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>.*” The previous link includes information related to the university’s Honor Policy, DRC, Academic and Health Resources. Additional information for graduate students that includes grading and attendance, "Graduate Level Academic Policies and Regulations (Attendance and Grading policy): <https://gradcatalog.ufl.edu/graduate/regulations/>"

9.1 Students Requiring Accommodations

Disability accommodations: contact the Disability Resource Center, <https://disability.ufl.edu/students/get-started/>.

9.2 Course Evaluations

GatorEvals: <https://gatorevals.aa.ufl.edu/students/>.

9.3 In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

9.4 University Honesty Policy

Honor Pledge: “On my honor, I have neither given nor received unauthorized aid...”. <https://policy.ufl.edu/regulation/4-040/>

9.5 Commitment to a Safe and Inclusive 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
- Dr. Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu

9.6 Software Use

Adhere to software licensing laws; violations may incur penalties.

9.7 Student Privacy

FERPA information: <https://registrar.ufl.edu/ferpa.html>

9.8 Campus Resources

9.8.1 Health and Wellness

- U Matter, We Care: umatter@ufl.edu, 352-392-1575.
- Counseling & Wellness Center: <https://counseling.ufl.edu/>, 392-1575.
- University Police: 392-1111 or 9-1-1.

9.8.2 Academic Resources

- E-learning support: <https://elearning.ufl.edu/.../student-help-faqs/>, 352-392-4357.
- Career Connections Center: <https://career.ufl.edu/>, 392-1601.
- Library Support: <http://cms.uflib.ufl.edu/ask>.
- Teaching Center: <https://teachingcenter.ufl.edu/>, 392-2010.
- Writing Studio: <https://writing.ufl.edu/writing-studio/>, 846-1138.
- Student Complaints: <https://www.ombuds.ufl.edu/complaint-portal/>.

10 Required Computer

Recommended Computer Specifications: <https://it.ufl.edu/.../student-computer-recommendations/>
HWCOE Computer Requirements: <https://www.eng.ufl.edu/.../computer-requirements/>

11 Use of AI-Assisted Tools

Generative-AI platforms (e.g., ChatGPT, GitHub Copilot, Claude) may be used in this course for idea generation, editing, debugging, or study support, provided you: (1) evaluate and verify all content the tool produces, (2) ensure the final submission represents your own understanding and analytical effort, and (3) disclose any substantive AI assistance (tool, date, and purpose) in a brief footnote or code comment. Unattributed or wholesale adoption of AI output, or use that circumvents learning objectives, constitutes academic misconduct under the UF Honor Code. Remember that AI models can fabricate references, misstate facts, and reproduce copyrighted or biased material; you are responsible for the accuracy, originality, and ethical integrity of everything you submit. Questions about appropriate use will be discussed in class as AI capabilities and university guidance evolve.

12 Changelog

1.0 2025-07-15: Original version.