

NE 231 – Principles of Nuclear Engineering – Spring 2024

Instructor: Eric Lang

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Office Location: FEC 1100

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Office Hours: Mondays, Wednesdays 11am

Class Meeting Days: Tuesday and Thursday

Class Time: 9:30-10:50 am

Class Location: Mech 214

Term: Spring 2024

Credits: 3 hours

Course Description: Principles of Nuclear Engineering (3). Introduction to nuclear engineering and nuclear processes; neutron interactions with matter; cross-sections; fission; neutron diffusion; criticality; kinetics; chain reactions; reactor principles; fusion; nuclear fuel cycle; safety

Prerequisites: CHEM 1215, CHEM 1215L, MATH 1522

Corequisite: NE 314

Course Goals: This course is designed to introduce sophomores to the broad field of nuclear engineering by introducing them to fundamental concepts that they will encounter and develop analytical skills to allow them to solve nuclear engineering problems. NE 230 focused on charged particle and radiation processes and interactions with matter, whereas NE 231 will focus on nuclear phenomena of the nucleus.

Introduction: Principles of Nuclear Engineering teaches the fundamental skill set of nuclear engineering with concepts focused on processes of the nucleus. This is a core class in the NE curriculum and serves as a prerequisite to many upper-level NE courses. The course consists of 11 main modules, some of which are longer than others and will require more in and out of class time. There is a design problem that will require the use of Matlab or a similar programming language to accomplish the task. There are no labs associated with the course.

Course Topics:

1. Review of number densities and binding energies – 2 lectures
2. Neutron interactions, cross-sections, and attenuation – 2 lectures
3. Energy loss and scattering – 2 lectures
4. Fission – 3 lectures
5. Neutron Diffusion – 3 lectures
6. One-group critical reactors – 3 lectures
7. Critical equations and bare thermal reactors – 3 lectures
8. Nuclear Power Reactors – 3 lectures
9. Nuclear Fuel Cycle – 2 lectures
10. Nuclear Fusion – 2 lectures
11. Safety and Ethics – 1 lecture

Design Problems:

1. Decay Scheme Calculation

Student Learning Outcomes:

1. Understand and apply physics to nuclear engineering problems.
2. Calculate atomic number densities and compounds and mixtures.
3. Define fission, fissionable, fertile.
4. Sketch binding energy curves and cross-section curves.
5. Calculate fractional energy loss of neutrons in scattering processes.
6. Use sub-critical, critical, and supercritical correctly when describing reactors.
7. Calculate infinite multiplication factors.
8. Explain the function of reflectors.
9. Use the one-group critical solutions to solve for critical masses and dimensions of bare reactors.
10. Sketch the nuclear fuel cycle and main features of pressurized water and boiling water reactors.

Textbook:

John R. Lamarsh and Anthony J. Baratta, *Introduction to Nuclear Engineering*, 3rd ed., Prentice Hall, 2001.

Grading:

Homework: 45% (13 total)

Three Exams: 45% (15% each)

Oral Quiz: 5%

In-class Quizzes: 3%

Group Activities Participation: 2%

Homework:

Homework will be collected in-person at the start of class the day it is due. I will put the due date and time on each assignment. Late work will be accepted for a grade with a 10% reduction in grade per day. You will be granted one extension on a single assignment in the semester.

Exams:

There will be 2 midterm exams and 1 final exam. Each will be weighted equal amounts. The final exam will be cumulative but will focus on the content in the final 1/3 of the course.

In-class Quizzes:

There will be 3 in-class quizzes throughout the semester. They will not be announced but they will be roughly evenly spaced throughout the semester. They will cover topic from the past few lectures, and will take about 10-15 minutes at the start or end of a class period.

Oral Quiz:

At the end of the semester, we will do an oral quiz, one-on-one with Dr. Lang. You will be given an image and asked a few questions about it. You will not be able to use notes. You will be graded on your ability to answer the questions, in terms of technical knowledge and delivery.

Group Activities:

We will do about 6-7 in-class group activities throughout the semester. These will be graded for participation only.

Grades:

Letter grade will be based on the following scale:

A+ 97-100	C- 70-72
A 93-96
A- 90-92	D+ 67-69
.....	D 63-66
B+ 87-89	D- 60-62
B 83-86	
B- 80-82	
.....	
C+ 77-79	
C 73-76	

Website:

Canvas will be the main medium for communication and submitting coursework. All assigned texts, assignments, and announcements will be posted electronically, and it is the student’s obligation to routinely check the contents of the course site. Students are expected to check messages at their UNM email accounts on record. From time to time the instructor will send notices about the class via email and via UNM Canvas. You are expected to check your e-mail and the Canvas page for the course routinely. <https://canvas.unm.edu/courses/23281>

Accommodation Statement:

Accessibility Services (Mesa Vista Hall 2021, 277-3506) provides academic support to students who have disabilities. If you think you need alternative accessible formats for undertaking and completing coursework, you should contact this service right away to assure your needs are met in a timely manner. If you need local assistance in contacting Accessibility Services, see the Bachelor and Graduate Programs office.

Academic Integrity:

The University of New Mexico believes that academic honesty is a foundation principle for personal and academic development. All University policies regarding academic honesty apply to this course. Academic dishonesty includes, but is not limited to, dishonesty in quizzes or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or outside the university; and nondisclosure or misrepresentation in filling out applications or other university records. All students are expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, including dismissal, against any student found responsible for academic dishonesty or failing to meet the standards. Any student judged to engage in academic dishonesty may receive a reduced or failing grade for work in question and/or the course. The University's full statement on academic honesty and the consequences for failure to comply is available in the college catalog and in the Pathfinder.

Title IX:

In an effort to meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered “responsible employees by the department of Education (see pg 15 - [http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title- ix.pdf](http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf)). This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct and sexual violence

made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu). For more information on the campus policy regarding sexual misconduct, see: <https://policy.unm.edu/university-policies/2000/2740.html>.

COVID-19 Health and Awareness:

UNM is a mask friendly, but not a mask required, community. To be registered or employed at UNM, Students, faculty, and staff must all meet UNM's Administrative Mandate on Required COVID-19 vaccination. If you are experiencing COVID-19 symptoms, please do not come to class. If you have a positive COVID-19 test, please stay home for five days and isolate yourself from others, per the Centers for Disease Control (CDC) guidelines. If you do need to stay home, please communicate with me at (505) 277-0772 or by email; I can work with you to provide alternatives for course participation and completion. UNM faculty and staff know that these are challenging times. Please let me, an advisor, or another UNM staff member know that you need support so that we can connect you to the right resources. Please be aware that UNM will publish information on websites and email about any changes to our public health status and community response.

Support:

Student Health and Counseling (SHAC) at (505) 277-3136. If you are having active respiratory symptoms (e.g., fever, cough, sore throat, etc.) AND need testing for COVID-19; OR If you recently tested positive and may need oral treatment, call SHAC.

LoboRESPECT Advocacy Center (505) 277-2911 can offer help with contacting faculty and managing challenges that impact your UNM experience.

Connecting to Campus and Finding Support:

UNM has many resources and centers to help you thrive, including opportunities to get involved, mental health resources, academic support including tutoring, resource centers for people like you, free food at Lobo Food Pantry, and jobs on campus. Your advisor, staff at the resource centers and Dean of Students, and I can help you find the right opportunities for you.

Respectful and Responsible Learning:

We all have shared responsibility for ensuring that learning occurs safely, honestly, and equitably. Submitting material as your own work that has been generated on a website, in a publication, by an artificial intelligence algorithm, by another person, or by breaking the rules of an assignment constitutes academic dishonesty. It is a student code of conduct violation that can lead to a disciplinary procedure. Please ask me for help in finding the resources you need to be successful in this course. I can help you use study resources responsibly and effectively. Off-campus paper writing services, problem-checkers and services, websites, and AIs can be incorrect or misleading. Learning the course material depends on completing and submitting your own work. UNM preserves and protects the integrity of the academic community through multiple policies including policies on student grievances (Faculty Handbook D175 and D176), academic dishonesty (FH D100), and respectful campus (FH CO9). These are in the Student Pathfinder (<https://pathfinder.unm.edu>) and the Faculty Handbook (<https://handbook.unm.edu>).

Course Schedule

The Course Schedule is subject to change. Minor changes will be announced in class, major ones provided in writing.

Spring 2024 – Course Schedule (subject to change)		
Date	Class Topics	Work Due
January 16 th	Syllabus and Review of number densities and binding energies	
January 18 th	Review of number densities and binding energies	
January 23 rd	Neutron interactions, cross-sections, and attenuation	
January 25 th	Neutron interactions, cross-sections, and attenuation	HW 1
January 30 th	Energy loss and scattering	
February 1 st	Energy loss and scattering	HW 2
February 6 th	Fission	
February 8 th	Fission	HW 3
February 13 th	Fission	
February 15 th	Midterm 1	
February 20 th	Neutron Diffusion	HW 4
February 22 nd	Neutron Diffusion	
February 27 th	Neutron Diffusion	HW 5
February 29 th	One-group critical reactors	
March 5 th	One-group critical reactors	HW 6
March 7 th	One-group critical reactors	
March 12 th	Spring Break	
March 14 th	Spring Break	
March 19 th	Critical equations and bare thermal reactors	HW 7
March 21 st	Critical equations and bare thermal reactors	
March 26 th	Critical equations and bare thermal reactors	
March 28 th	Midterm 2	HW 8
April 2 nd	Nuclear Power Reactors	
April 4 th	Nuclear Power Reactors	HW 9
April 9 th	Nuclear Power Reactors	
April 11 th	Nuclear Fuel Cycle	HW 10
April 16 th	Nuclear Fuel Cycle	
April 18 th	Nuclear Fusion	HW 11
April 23 rd	Nuclear Fusion	
April 25 th	Safety and Ethics	HW 12
April 30 th	Buffer Day	
May 2 nd	Review	HW 13
TBD	Final Exam	

n.b. I want you all to succeed in the course. I want you all to learn and be excited about nuclear engineering exiting the course. We will establish the fundamentals that will be expanded upon in future courses. I will try to tie each lecture to existing research to show you how it is relevant.