NPRE247: Modeling Nuclear Energy Systems

University of Illinois, Urbana-Champaign

Spring 2023

Instructor:	Dr. Madicken Munk	**Time:**	MWF 10:00– 10:50
Email:	mmunk2@illinois.edu	**Place:**	3038 Campus Instructional Facility
Course Zoom:	https://illinois.zoom.us/j/85997782066?pwd=WnBwaXBJU24vSmxaL3FqUEtNWkhnZz09		

Course Pages:

1. https://canvas.illinois.edu/courses/35562
2. https://www.gradescope.com/courses/497029
3. https://github.com/munkm/npre247
4. https://mybinder.org/v2/gh/munkm/npre247/23-spring

Course Zoom: A persistent zoom link (https://illinois.zoom.us/j/85997782066?pwd=WnBwaXBJU24vSmxaL3FqUEtNWkhnZz09) for our course is included in the syllabus and on the course Canvas page. This zoom will only be active when campus requires that we have remote instruction (e.g. the first week of classes this semester). It will not be active if there is in person instruction unless Dr. Munk announces it later in the semester.

TA Office Hours: The teaching assistants for the course will hold office hours in the 220 Talbot Laboratory Student Lounge. Arthur Mazzeo will hold office hours Date Unknown from TBA to TBA and Ceser Zambrano will hold office hours Date Unknown from TBA to TBA. Grade disputes will not be addressed in TA office hours.

Office Hours: Dr. Munk will hold office hours on Fridays from 11:00 a.m. to 11:50 a.m. in 118 Talbot Laboratory, 104 S. Wright St. Supplemental office hours are by appointment only and will never be available with less than 24 hours notice. Before making an appointment, please try the following options:

- If your colleagues might be helpful, please post your questions in the canvas discussion forum provided for this purpose.
- If the TAs might be helpful, please attend their office hours.

- Email Dr. Munk. If possible, please phrase your question such that it can be answered 'Yes' or 'No'. Questions which require substantial response should be asked during the lecture or office hours.

If none of the above are successful or appropriate, you may email me with a selection of times of your availability and we can find a time that is mutually agreeable.

Main References: A few essential references for this course will be assigned as readings. The required text for this course is [1] while [2] is also recommended. For assistance in computational projects, [3] is available online and in the library as an ebook.

[1] J. Kenneth Shultis and Richard E. Faw. *Fundamentals of Nuclear Science and Engineering*. CRC Press, Boca Raton, 3 edition edition, September 2016.

[2] John R. Lamarsh and Anthony J. Baratta. *Introduction to Nuclear Engineering*. Pearson, Hoboken, NJ, 4 edition edition, January 2017.

[3] Anthony Scopatz and Kathryn D. Huff. *Effective Computation in Physics*. O'Reilly Media, S.l., 1st edition, May 2015. https://www.safaribooksonline.com/library/view/effective-computation-in/9781491901564/.

Objectives: This course will equip students to:

- Apply elementary nuclear physics to nuclear engineering.
- Classify and compare nuclear reactor materials and components.
- Evaluate steady-state and transient operation of nuclear reactors.
- Calculate aspects of nuclear energy removal and conversion.
- Select and simulate radiation shielding.

Prerequisites:

- PHYS 212
- MATH 285 (credit or concurrent registration)

Grading Policy: Grades will be assigned as a weighted sum of the following work.

Work	**Weight**
Quizzes	(10%)
Homework	(15%)
Computer Projects	(30%)
Midterm 1	(15%)
Midterm 2	(15%)
Final Exam	(15%)
Total	(100%)

Important Dates:

Midterm #1	February 13, 2022, 10:00am
Midterm #2	March 31, 2022, 10:00am
CP1 Deadline	TBD, 11:59pm
CP2 Deadline	TBD, 11:59pm
CP3 Deadline	TBD, 11:59pm
Final Exam	Month, Day, Year, Time

Class Policies:

Integrity: This is an institution of higher learning. You will be swiftly ejected from the course if you are caught undermining its integrity. Note the Student's Quick Reference Guide to Academic Integrity and the Academic Integrity Policy and Procedure.

Attendance: Regular attendance is expected. Request approval for absence for extenuating circumstances prior to absence.

Electronics: Active participation is essential and expected. Accordingly, students must turn off all electronic devices (laptop, tablets, cellphones, etc.) during class. Exceptions may be granted for laptops and tablets if engaging in computational exercises or taking notes.

Collaboration: Collaboratively reviewing course materials and studying for exams with fellow students can be enriching. This is recommended. However, unless otherwise instructed, homework assignments are to be completed independently and materials submitted as homework should be the result of one's own independent work. Dr. Munk recommends working through the problems independently and then checking work with peers. Explaining your process is a good exercise to retain course material.

Late Work: Late work will not be accepted. Plan ahead. We will drop the lowest scoring homework and quiz grade for each student. This shall accomodate unforseen circumstances that may contribute to a missed quiz or homework assignment.

Make-up Work: There will be no negotiation about late work except in the case of absence documented by an absence letter from the Dean of Students. The university policy for requesting such a letter is in the Student Code. Please note that such a letter is appropriate for many types of conflicts, but that religious conflicts require special early handling. In accordance with university policy, students seeking an excused absence for religious reasons should complete the Request for Accommodation for Religious Observances Form The student should submit this form to the instructor and the Office of the Dean of Students by the end of the second week of the course to which it applies.

Grade Disputes: It is important that you understand and agree with the grade you receive on assignments and exams. If you would like to dispute your score, you must send an explanation by email to Dr. Munk within one week of recieving the grade. **Do not expect us to regrade anything while in conversation with you** as that would not be fair to the other students in the class, whose homeworks were graded without them present. If you request a regrade, be aware that the it is possible that your score will go down. Regrade requests should be based on an error on our part (e.g., adding up the points incorrectly) or what you suspect is a misunderstanding of your work (e.g., arriving at the correct answer using an unexpected technique). Regrade requests that argue with the rubric (e.g., "this is wrong, but you took too many points off") will be returned without consideration. **Your work should stand alone.** If an assignment is disorganized or ambiguous, and requires an extensive explanation to the grader, you will likely still lose

points. The homeworks not only evaluate your understanding of the material - they also evaluate your ability to communicate that understanding clearly and concisely.

Accessibility: I hope that this course will be inclusive and accommodating for all learners. As such, I am committed upholding the vision and values of Inclusive Illinois in my classroom. With regard to accommodating all learners, please note that many resources are provided through the Division of Disability Resources and Educational Services. To request particular accommodations, please contact me as soon as possible so that we can work out any necessary arrangements.

Safety: Emergencies can happen anywhere and at any time, so its important that we take a minute to prepare for a situation in which our safety could depend on our ability to react quickly. Take a moment to learn the different ways to leave this building. If there's ever a fire alarm or something like that, youll know how to get out and you'll be able to help others get out. Next, figure out the best place to go in case of severe weather - we'll need to go to a low-level in the middle of the building, away from windows. And finally, if there's ever someone trying to hurt us, our best option is to run out of the building. If we cannot do that safely, we'll want to hide somewhere we can't be seen, and we'll have to lock or barricade the door if possible and be as quiet as we can. We will not leave that safe area until we get an Illini-Alert confirming that it's safe to do so. If we can't run or hide, we'll fight back with whatever we can get our hands on. If you want to better prepare yourself for any of these situations, visit `police.illinois.edu/safe`. Remember you can sign up for emergency text messages at `emergency.illinois.edu`. This one-page-handout discusses the Illinois Run-Hide-Fight strategy.

Other Resources: University students typically experience a wide range of stressors during their time on campus. Accordingly, campus resources exist to help students manage stress levels, mental health, physical health, and emergencies while navigating this environment. I hope you will take advantage of these campus resources.

- The Campus Recreational Centers
- The Counselling Center
- The McKinley Mental Health Clinic
- The Emergency Dean

Course Schedule: *Note that this schedule is subject to change.*

Date	Week	Day	Unit	Chap.	Quiz Given	Quiz Due	HW Given	HW Due
1/18	1	W	Intro		1			
1/20	1	F	Fundamentals	1	2	1	1	
1/23	2	M	Modern Physics	2		2		
1/25	2	W	Modern Physics	2				
1/27	2	F	Nuclear Models	3	3		2	1
1/30	3	M	Nuclear Energetics	4		3		
2/1	3	W	Nuclear Energetics	4				
2/3	3	F	Radioactivity	5	4		3	2
2/6	4	M	Radioactivity	5		4		
2/8	4	W	Radioactivity	5				
2/10	4	F	Review		5		4	3
2/13	5	M	Exam 1			5		
2/15	5	W	Radioactivity	6				
2/17	5	F	Exam I Review	6	6		5	4
2/20	6	M	Intro to Python	6		6		
2/22	6	W	Binary Nuc. Rxns.					
2/24	6	F	Binary Nuc. Rxns.	6	7		6	5
2/27	7	M	Binary Nuc. Rxns.			7		
3/1	7	W	Rad. Int. w/Matter	6				
3/3	7	F	Rad. Int. w/Matter	7	8		7	6
3/6	8	M	Neutron Balance	7		8		
3/8	8	W	Neutron Balance	9				
3/10	8	F	Criticality	10	9		8	7
3/13	9	M	**Spring Break**					
3/15	9	W	**Spring Break**					
3/17	9	F	**Spring Break**					
3/20	10	M	6 factor	10		9		
3/22	10	W	6 factor	10				
3/24	10	F	Exam 2	10	10		9	8
3/27	11	M	6 Factor	10		10		
3/29	11	W	Criticality	10				
3/31	11	F	Nuclear Reactors		11		10	9
4/3	12	M	Diffusion	10		11		
4/5	12	W	Diffusion	10		10		
4/7	12	F	Diffusion	10	12		11	10
4/10	13	M	Diffusion	10		12		
4/12	13	W	Nuclear Fuel Cycles	10				
4/14	13	F	**Student Conference**	10	13		12	11
4/17	14	M	Exam 2 Review			13		
4/19	14	W	Ethics	10				
4/21	14	F	Ethics	10	14		13	12
4/24	15	M	Reactivity Feedback	10		14		
4/26	15	W	Fission Prod. Poison	11		14		
4/28	15	F	Fission Prod. Poison	11			14	13
5/1	16	M	Nuclear Power					
5/3	16	W	Review					14
TBD	–	–	**Final Exam**					