NPRE412: Nuclear Power Economics and Fuel Management

University of Illinois, Urbana-Champaign

Spring 2020

Instructor:	Prof. Kathryn Huff	**Time:**	MWF 10:00am– 10:50am
Email:	kdhuff@illinois.edu	**Place:**	225A Talbot Laboratory

Course Pages:

1. https://compass2g.illinois.edu
2. https://github.com/katyhuff/NPRE412

TA Office Hours: The teaching assistant for the course, Gwendolyn Chee, will hold office hours Mondays and Tuesdays from 2pm to 3pm in 226 Talbot Laboratory.

Professor Office Hours: Prof. Huff will hold office hours by appointment only, in her office, 118 Talbot Laboratory. Please make use of the teaching assistant and your colleagues before booking an appointment with Prof. Huff. You can make an appointment at katyhuff.youcanbook.me. Appointments must be booked at least 24 hours ahead of time. If the door to 118 Talbot Laboratory is open, Prof. Huff may be available for very brief questions. In that case, feel free to drop by.

Main References: A few essential references for this course will be assigned as readings. The recommended text for this course is [1].

[1] Nicholas Tsoulfanidis. *The Nuclear Fuel Cycle*. American Nuclear Society, La Grange Park, Illinois, USA, 2013. 00177. 1

Objectives: This course will equip students to:

- Quantify impacts of the nuclear power industry
- Calculate nuclear fuel cycle and capital costs for thermal and fast reactors.
- Optimize nuclear fuel management for lowest energy costs and highest system performance.
- Differentiate among features of fossil fuel systems, fission systems, and controlled thermonuclear fusion systems.
- Quantiatively analyze nuclear fuel cycle technologies for both once-through and closed strategies.
- Comparatively assess spent fuel storage, reprocessing, and disposal strategies.

Prerequisites:

- Junior standing is encouraged.
- NPRE 402 or 247

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

Work	Weight (Undergraduate)	Weight (Graduate)
Quizzes	(10%)	(0%)
Homework	(30%)	(30%)
Midterm	(20%)	(20%)
Proj. Proposal	(20%)	(20%)
Final Proj.	(20%)	(20%)
Total	(100%)	(100%)

Important Dates:

Midterm ..... 10:00-10:50am, March 13, 2020
Final Exam ..... 7:00-10:00 p.m., Tuesday, May 12, 2020

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 mandatory. 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 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.

Late Work: Late work has a halflife of 1 hour. That is, adjusted for lateness, your grade $G(t)$ is a decaying percentage of the raw grade G_0. An assignment turned in t hours late will receive a grade according to the following relation:

$$G(t) = G_0 e^{-\lambda t}$$

where

$$G(t) = \text{grade adjusted for lateness}$$
$$G_0 = \text{raw grade}$$
$$\lambda = \frac{ln(2)}{t_{\frac{1}{2}}} = \text{decay constant}$$
$$t = \text{time elapsed since due [hours]}$$
$$t_{1/2} = 1 = \text{half-life [hours]}$$

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, which can be found on the Office of the Dean of Students website. 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 Prof. Huff within one week of recieving the grade. **Do not expect me 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 entire assignment will be regraded and is subject to double-jeopardy: it is possible that your score will go down. Regrade requests should be based on an error on my 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.

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 as soon as they can be of help.

- The Campus Recreational Centers
- The Counselling Center

- The McKinley Health Clinic
- The McKinley Mental Health Clinic
- The Emergency Dean

Run. Hide. Fight. It is important that we take time to prepare for a situation in which our safety could depend on our ability to react quickly. Please review the university guidance on responding to emergency situations https://police.illinois.edu/emergency-preparedness/run-hide-fight/. Take a moment to learn the different ways to leave this building. If there's ever a fire alarm or something like that, you'll 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.

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

Date	Week	Day	Unit	Chap.	Quiz	HW Given	HW Due
01-22	1	W	Intro	1			
01-24	1	F	Overview	1		HW1	
01-27	2	M	Overview	1	Q1		
01-29	2	W	Economics	8			
01-31	2	F	Economics	8		HW2	HW1
02-03	3	M	Economics	8	Q2		
02-05	3	W	Economics	8			
02-07	3	F	Economics	8		HW3	HW2
02-10	4	M	Mining & Milling	2	Q3		
02-12	4	W	Mining & Milling	2			
02-14	4	F	Mining & Milling	2		HW4	HW3
02-17	5	M	Conversion	3	Q4		
02-19	5	W	Enrichment	3			
02-21	5	F	Enrichment	3		HW5	HW4
02-24	6	M	Enrichment	3	Q5		
02-26	6	W	Enrichment	3			
02-28	6	F	Fuel Fabrication	4		HW6	HW5
03-02	7	M	Fuel Fabrication	4	Q6		
03-04	7	W	Reactors	5			
03-06	7	F	Reactors	5		HW7	HW6
03-09	8	M	Reactors	5	Q7		
03-11	8	W	Reactors	5			
03-13	8	F	• **Midterm** •			HW8	HW7
03-16	9	M	• **No Class** •				
03-18	9	W	• **No Class** •				
03-20	9	F	• **No Class** •				
03-23	10	M	Fuel In-Core	6	Q9		
03-25	10	W	Fuel In-Core	6			
03-27	10	F	Reprocessing	7		HW9	HW8
03-30	11	M	Reprocessing	7	Q10		
04-01	11	W	Reprocessing	7			
04-03	11	F	Reprocessing	7		HW10	HW9
04-06	12	M	Reprocessing	7	Q11		
04-08	12	W	HLW	9			
04-10	12	F	HLW	9		HW11	HW10
04-13	13	M	HLW	9	Q12		
04-15	13	W	HLW	9			
04-17	13	F	HLW	9		HW12	HW11
04-20	14	M	LLW	10	Q13		
04-22	14	W	LLW	10			
04-24	14	F	Nonproliveration	11		HW13	HW12
04-27	15	M	Nonproliferation	11	Q14		
04-29	15	W	Environment	12			
05-01	15	F	Environment	12			HW13
05-04	16	M	Environment	12	Q15		
05-06	16	W	Environment	12			
05-12	17	T	• **Final Exam** •				