

# NPRE412: Nuclear Power Economics and Fuel Management

University of Illinois, Urbana-Champaign

Spring 2021

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**Instructor:** Prof. Kathryn Huff

**Time:** MWF 10:00am– 10:50am

**Email:** [kdhuff@illinois.edu](mailto:kdhuff@illinois.edu)

**Place:** Zoom: 818 6930 4430, PW: 412

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## Course Pages:

1. <https://compass2g.illinois.edu>
2. <https://github.com/katyhuff/NPRE412>
3. <https://mybinder.org/v2/gh/katyhuff/npre412/master>
4. Zoom: 818 6930 4430, PW: 412

**Professor Office Hours:** Prof. Huff will hold office hours by appointment on Zoom. You can make an appointment at [katyhuff.youcanbook.me](https://katyhuff.youcanbook.me). Appointments must be booked at least 24 hours ahead of time.

**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.
- Quantitatively 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	(20%)	(30%)
Project Proposal	(20%)	(20%)
Long Read	(20%)	(20%)
Final Project	(30%)	(30%)
Total	(100%)	(100%)

**Important Dates:**

Final Presentations 8:00-11:00 a.m., Friday, May 14, 2021

**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

$G(t)$  = grade adjusted for lateness

$G_0$  = raw grade

$\lambda = \frac{\ln(2)}{t_{\frac{1}{2}}} = \text{decay constant}$

$t$  = time elapsed since due [hours]

$t_{1/2} = 1 = \text{half-life [hours]}$

**COVID** This course will take place online. If any components of the course are made available in person, they will be optional. Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community, including wearing a facial covering properly, maintaining social distance (at least 6 feet from others at all times), disinfecting the immediate seating area, and using hand sanitizer. Students are also required to follow the campus COVID-19 testing protocol.

Students who feel ill must not come to in-person class activities. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

**Emergency response recommendations** can be found at [this website](#). I encourage you to review this website and the campus building [floor plans website](#) within the first 10 days of class. 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](#).

**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](#). I am sensitive to the global pandemic situation and COVID-related challenges will be accommodated. 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 receiving 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.

**Anti-Racism and Inclusivity Statement** The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community. The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the [Bias Assessment and Response Team \(BART\)](#). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

**Disability-Related Accommodations** To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to [disability.illinois.edu](http://disability.illinois.edu). If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting “Request an Academic Screening” at the bottom of the page.

**Family Educational Rights and Privacy Act (FERPA)** Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See [this link](#) for more information on FERPA.

**Religious Observances** Illinois law requires the University to reasonably accommodate its students’ religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at [this link](#) to request appropriate accommodations. This should be done in the first two weeks of classes.

**Sexual Misconduct Reporting Obligation:** The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found [here](#). Other information about resources and reporting is available here: [wecare.illinois.edu](http://wecare.illinois.edu).

**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](#)

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

Date	Week	Day	Unit	Chap.	Quiz	HW Given	HW Due
01-25	1	M	Intro	1			
01-27	1	W	Overview	1			
01-29	1	F	Economics	8		HW2	HW1
02-01	2	M	Economics	8	Q1		
02-03	2	W	Economics	8			
02-05	2	F	Economics	8		HW3	HW2
02-08	3	M	Economics	8	Q2		
02-10	3	W	Mining & Milling	2			
02-12	3	F	Mining & Milling	2		HW4	HW3
02-15	4	M	Mining & Milling	2	Q3		
02-17	4	W	<b>No Class</b>				
02-19	4	F	Conversion	3		HW5	HW4
02-22	5	M	Enrichment	3	Q4		
02-24	5	W	Enrichment	3			
02-26	5	F	Enrichment	3		HW6	HW5
03-01	6	M	Fuel Fabrication	4	Q5		
03-03	6	W	Fuel Fabrication	4			
03-05	6	F	Fuel Fabrication	4		HW7	HW6
03-08	7	M	Reactors	5	Q6		
03-10	7	W	Reactors	5			
03-12	7	F	Reactors	5		HW8	HW7
03-15	8	M	Reactors	5	Q7		
03-17	8	W	Fuel In-Core	6			
03-19	8	F	Fuel In-Core	6		HW9	HW8
03-22	9	M	Fuel In-Core	6	Q8		
03-24	9	W	<b>No Class</b>				
03-26	9	F	Reprocessing	7		HW10	HW9
03-29	10	M	Reprocessing	7	Q9		
03-31	10	W	Reprocessing	7			
04-02	10	F	Reprocessing	7		HW11	HW10
04-05	11	M	Reprocessing	7	Q10		
04-07	11	W	Reprocessing	7			
04-09	11	F	HLW	9		HW12	HW11
04-12	12	M	HLW	9	Q11		
04-14	12	W	HLW	9			
04-16	12	F	HLW	9		HW13	HW12
04-19	13	M	LLW	10	Q12		
04-21	13	W	LLW	10			
04-23	13	F	LLW	10		HW14	HW13
04-26	14	M	Nonproliferation	11	Q13		
04-28	14	W	Nonproliferation	11			
04-30	14	F	Environment	12			HW14
05-03	15	M	Environment	12	Q14		
05-05	15	W	Environment	12			
05-14	16	F	● Presentations ●				