# NPRE412: Nuclear Power Economics and Fuel Management

University of Illinois, Urbana-Champaign

Fall 2017

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| **Instructor:** | Prof. Kathryn Huff | **Time:** | MWF 10:00am– 10:50am |
| **Email:** | kdhuff@illinois.edu | **Place:** | 106B1 Engineering Hall |


**Course Pages:**

1. https://compass2g.illinois.edu
2. https://github.com/katyhuff/NPRE412
3. https://piazza.com/illinois/fall2017/NPRE412/home

**TA Office Hours:** The teaching assistant for the course, Greg Westphal, will hold office hours Mondays and Tuesdays from 2pm to 3pm in Talbot Laboratory 2nd floor student lounge.

**Office Hours:** Prof. Huff will hold office hours on Tuesdays and Fridays from 3pm-COB in her office, 118 Talbot Laboratory at 104 S. Wright St. If you have an individual issue, please make an appointment. If your colleagues might be helpful, please post your questions in the forum provided for this purpose online rather than attending office hours.

**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 required.
- NPRE 402 or 247

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

| Work | Weight (Undergraduate) | Weight (Graduate) |
|---|---|---|
| **Quizzes** | (20%) | (0%) |
| **Homework** | (40%) | (40%) |
| **Midterm 1** | (10%) | (10%) |
| **Midterm 2** | (10%) | (10%) |
| **Final Exam** | (20%) | (20%) |
| **Final Proj.** | (0%) | (20%) |
| **Total** | (100%) | (100%) |

**Important Dates:**

Midterm #1 ..... 10:00-10:50am, October 3, 2017
Midterm #2 ..... 10:00-10:50am, November 7, 2017
Final Exam ..... 1:30-4:30pm, December 14, 2017

**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.

**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 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 |
|---|---|---|---|---|---|---|---|
| 08-28 | 1 | M | Intro | 1 | | | |
| 08-30 | 1 | W | Overview | 1 | | | |
| 09-01 | 1 | F | Overview | 1 | | HW1 | |
| 09-04 | 2 | M | • **No Class** • | 8 | Q1 | | |
| 09-06 | 2 | W | Economics | 8 | | | |
| 09-08 | 2 | F | Economics | 8 | | HW2 | HW1 |
| 09-11 | 3 | M | Economics | 8 | Q2 | | |
| 09-13 | 3 | W | Economics | 8 | | | |
| 09-15 | 3 | F | Economics | 8 | | HW3 | HW2 |
| 09-18 | 4 | M | Mining & Milling | 2 | Q3 | | |
| 09-20 | 4 | W | Mining & Milling | 2 | | | |
| 09-22 | 4 | F | Conversion | 3 | | HW4 | HW3 |
| 09-25 | 5 | M | Enrichment | 3 | Q4 | | |
| 09-27 | 5 | W | Enrichment | 3 | | | |
| 09-29 | 5 | F | Enrichment | 3 | | HW5 | HW4 |
| 10-02 | 6 | M | Fuel Fabrication | 4 | Q5 | | |
| 10-04 | 6 | W | Fuel Fabrication | 4 | | | |
| 10-06 | 6 | F | Fuel Fabrication | 4 | | HW6 | HW5 |
| 10-09 | 7 | M | • **Midterm** • | | Q6 | | |
| 10-11 | 7 | W | Reactors | 5 | | | |
| 10-13 | 7 | F | Reactors | 5 | | HW7 | HW6 |
| 10-16 | 8 | M | Reactors | 5 | Q7 | | |
| 10-18 | 8 | W | Fuel In-Core | 6 | | | |
| 10-20 | 8 | F | Fuel In-Core | 6 | | HW8 | HW7 |
| 10-23 | 9 | M | Fuel In-Core | 6 | Q8 | | |
| 10-25 | 9 | W | Reprocessing | 7 | | | |
| 10-27 | 9 | F | Reprocessing | 7 | | HW9 | HW8 |
| 10-30 | 10 | M | Reprocessing | 7 | Q9 | | |
| 11-01 | 10 | W | Reprocessing | 7 | | | |
| 11-03 | 10 | F | HLW | 9 | | HW10 | HW9 |
| 11-06 | 11 | M | HLW | 9 | Q10 | | |
| 11-08 | 11 | W | HLW | 9 | | | |
| 11-10 | 11 | F | HLW | 9 | | HW11 | HW10 |
| 11-13 | 12 | M | • **Midterm** • | | Q11 | | |
| 11-15 | 12 | W | HLW | 9 | | | |
| 11-17 | 12 | F | HLW | 9 | | HW12 | HW11 |
| 11-20 | 13 | M | • **No Class** • | | | | |
| 11-22 | 13 | W | • **No Class** • | | | | |
| 11-24 | 13 | F | • **No Class** • | | | | |
| 11-27 | 14 | M | LLW | 10 | Q12 | | |
| 11-29 | 14 | W | LLW | 10 | | | |
| 12-01 | 14 | F | Nonproliferation | 11 | | HW13 | HW12 |
| 12-04 | 15 | M | Environment | 12 | Q13 | | |
| 12-06 | 15 | W | Environment | 12 | | | |
| 12-08 | 15 | F | Environment | 12 | | | HW13 |
| 12-11 | 16 | M | Environment | 12 | | | |
| 12-13 | 16 | W | Review | | | | |
| 12-15 | 16 | F | • **No Class** • | | | | |
| 12-18 | 17 | M | • **No Class** • | | | | |
| 12-20 | 17 | W | • **Final Exam** • | | | | |