

NPRE555: Reactor Theory I

University of Illinois, Urbana-Champaign

Fall 2025

Instructor: Prof. Kathryn Huff

Time: MW 1:00pm– 2:50pm

Email: kdhuff@illinois.edu

Place: 106B3 Engineering Hall

Course Pages:

1. <https://canvas.illinois.edu/>
2. <https://github.com/katyhuff/NPRE555>
3. https://mediaspace.illinois.edu/playlist/dedicated/1_fetbf4t5\

Office Hours: Prof. Huff will hold office hours by appointment only and prefers to meet in her office, 111B Talbot Laboratory. Please make an appointment at <https://katyhuff.youcanbook.me>. If your colleagues might be helpful, please discuss your questions with them directly before scheduling office hours.

Main References: A few essential references for this course will be assigned as readings and will be the source of homework problems. The required texts for this course are [1] and [2]. I also recommend [3] for conceptual review and [4] for computational methods details. Electronic copies of these books can be found online if they are not available in the UIUC library.

- [1] Weston M. Stacey. *Nuclear reactor physics*. Wiley. com, 2007.
- [2] George I. Bell and Samuel Glasstone. *Nuclear Reactor Theory*. Van Nostrand Reinhold Company, New York, 1970.
- [3] James J. Duderstadt and William R. Martin. *Transport Theory*. Wiley, New York, 1979.
- [4] Elmer E. Lewis and Warren F. Miller Jr. *Computational Methods of Neutron Transport*. Amer Nuclear Society, La Grange Park, Ill, 2nd edition edition, January 1993.

Objectives:

- Advanced development of neutron transport theory
- neutron slowing-down,
- resonance absorption,
- approximations to the transport equation,

- direct numerical methods and other techniques of approximation theory applied to the neutron transport equation,
- and advanced topics.

Prerequisites:

- NPRES455 (waived for Physics Majors)

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

Work	Weight
Homework	(50%)
Project 1	(15%)
Project 2	(15%)
Final Project	(20%)
Total	(100%)

Important Dates:

Project #1 1:00pm, Monday October 6, 2025
Project #2 1:00pm, Monday November 10, 2025
Final Project 5:00pm, Wednesday Dec. 17, 2025
Presentation 7:00pm–10:00pm, Wednesday Dec. 17, 2025

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. If you are or become ill, please communicate with me and the Dean of Students regarding your expected need for accommodation in this class. I am willing, able, and ready to make necessary accommodations.

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 tablets or 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

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

t = time elapsed since due [hours]

$t_{1/2} = 1$ = 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.

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.

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 [Campus Belonging portal](#). Based on your report, Campus Belonging 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 or go to 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.

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. Stacey	Chap. B&G	HW Given	HW Due
08-25	1	M	Transport Eqn.	9	1	HW1	
08-27	1	W	Transport Eqn.	9	1	CP1	
09-01	2	M	Boundary Conds.	9	1	HW2	HW1
09-03	2	W	Boundary Conds.	9	1		
09-08	3	M	Angle & Energy	9	1	HW3	HW2
09-10	3	W	Angle & Energy	9	1		
09-15	4	M	Monte Carlo	9.12	1&2	HW4	HW3
09-17	4	W	Monte Carlo	9.12	1&2		
09-22	5	M	Monte Carlo	9.12	1&2	HW5	HW4
09-24	5	W	Monte Carlo	9.12	1&2		
09-29	6	M	P_N	9	3	HW6	HW5
10-01	6	W	P_N	9	3		
10-06	7	M	Multi-group P_N	9	4	CP2	CP1
10-08	7	W	Multi-group P_N	9	4		
10-13	8	M	P_N Eigenvalue Calcs.	9	4	HW7	HW6
10-15	8	W	P_N Eigenvalue Calcs.	9	4		
10-20	9	M	S_N	9	5	HW8	HW7
10-22	9	W	S_N	9	5		
10-27	10	M	S_N	9	5	HW9	HW8
10-29	10	W	S_N	9	5		
11-03	11	M	Adjoint Eqn.	13	6	HW10	HW9
11-05	11	W	Adjoint Eqn.	13	6		
11-10	12	M	Perturbation Theory	13	6	CP3	CP2
11-12	12	W	Variational Methods				
11-17	13	M	Neutron Slowing Down	10	7	HW11	HW10
11-19	13	W	Neutron Slowing Down	10	7		
11-24	14	M	Fall Break				
11-26	14	W	Fall Break				
12-01	15	M	Neutron Thermalization	11	7	HW12	HW11
12-03	15	W	Neutron Thermalization	11	7		
12-08	16	M	Resonance Absorption	12	11		HW12
12-10	16	W	Resonance Absorption	12	11		
12-17	17	W	Final Presentation			CP3	