Ghosts of Chernobyl:

Do the benefits of nuclear energy outweigh its risks?

Prof. Anders Knospe

Course Information:

Course Number: PHY 90 and EVST 90

Semester: Fall 2024

Meeting Day and Time: Tuesday and Thursday, 3:00–4:15 p.m. Eastern Time

Physical Meeting Location: Lewis Lab 512

Virtual Meeting Location: Zoom link on CourseSite (not the same as for Office Hours)

Instructor's Contact Information:

Office: Lewis Lab 412

Office Phone: 610-758-6431 (86431 on campus)

Main Physics Office Phone: 610-758-3931 (83931 on campus)

Email: ank220@lehigh.edu

Virtual Office Hour Location: Zoom link on CourseSite (not the same as for class meetings)

Pronouns: I use the "he" suite of pronouns. Please feel free to tell me yours.

Office Hours:

Tuesday 1:30–2:30 p.m. Eastern Time

Friday 4:00–5:00 p.m. Eastern Time

Or by appointment: I am happy to meet with you outside my scheduled office hours. Just ask.

I will be physically present in my office and also available for virtual meetings at these times. You are welcome to visit me in person or we can talk online. There will also be occasions during the semester when I will be unable to be present for in-person office hours; I will inform you of these. For virtual meetings, I will be logged into the Zoom room throughout the designated time. Please say hello when you log in so I know that you are there. If I have stepped away from the computer for a minute, please be patient and stick around: I will come back. Note that virtual office hours use a **different Zoom room** than lectures.

Course Description:

In 1986, a meltdown at the Chernobyl nuclear power plant in the Soviet Union (now Ukraine) resulted in the emission of a large amount of radioactive material and significant contamination of the environment. Through analysis of the HBO limited series *Chernobyl* and other media, this course will explore the complex question of whether the benefits of nuclear energy outweigh its risks. Students will learn about the basic principles underlying nuclear power, the human and environmental effects of nuclear power, the impacts of climate change, and the potential for cleaner and safer forms of nuclear power, as well as how the current war in Ukraine has impacted Chernobyl and its surrounding area.

Prerequsites:

There are no prerequisites for this course. I will assume a basic familiarity with high-school-level math and science concepts. If you are concerned that you may not have the right knowledge base, please let me know.

Course Learning Objectives:

By the end of this course, students will

1. understand basic concepts in nuclear physics.
2. understand in general terms how nuclear reactors work and the causes of some well-known nuclear accidents.
3. know the different types of radiation, how to protect from radiation, and common myths about radiation.
4. be able to discuss the impact of nuclear accidents on the bodies, literature, and societies of the surrounding communities.
5. be able to weigh the pros and cons of nuclear energy.
6. be able to discuss technical and storytelling aspects of the *Chernobyl* limited series, including the artistic liberties taken.

Required Media:

1. *Chernobyl*, a limited series created by Craig Mazin and first released on HBO. Episodes will be available to stream for free through the Lehigh University Library.
2. *The Chernobyl Poscast*, a companion podcast with Peter Sagal and Craig Mazin. Episodes are available through many podcast platforms.
3. *Voices from Chernobyl*, a documentary directed by Pol Crutchen. The film will be available to stream for free through the Lehigh University Library.
4. *Atoms and Ashes: a Global History of Nuclear Disasters*, by Serhii Plokhy, W. W. Norton & Company, 2022 ISBN–13: 978-1324021049, ISBN–10: 1324021047
5. Additional reading/viewing material, available at no cost to you, will be assigned throughout the semester.
6. Depending on what you choose for your final project, you may need to purchase other films or books at your own expense. But of course, please check the Lehigh Library first to see if you can get what you need there.

Attendance:

I will monitor attendance, which will be worth 15% of your grade. Each class meeting is worth 1 point. You will receive 1 point for attending the entire meeting in-person. You will receive 0 points if you are late, leave early, are absent, or attend remotely. You will need to put your name on the sign-in sheet at the front of the room before the start of each meeting. It is your job to remember to do this. No sign-in means no credit!

I understand that people are sometimes late, need to attend remotely, or need to miss a meeting. In such cases, I *may* be willing to give full credit if you have a good excuse. Examples of good excuses are being infected with avian flu or having a family emergency. An example of a bad excuse is "I overslept," (particularly for a class that starts at 3 p.m.!). I will be more likely to accept your excuse if you contact me **before** the meeting in question. Requests must be sent via email. You need to plan your travel so that you can fulfill your course obligations. "I have a plane to catch" is not a good excuse for missing a class meeting. Also, if you want me to write a letter of recommendation for you, you should really try to attend all meetings in-person.

Participation:

You will also be graded on participation in class discussions. This will be worth 20% of your grade. This includes question and answer periods with our guest speakers, longer discussion sessions where we will discuss a topic related to your reading or viewing, and engagement with presentations by other students in the course. Not every course meeting will have a component that contributes to your participation grade. You can get full participation credit even if you do not receive attendance points (due to unexcused lateness or remote attendance).

Virtual Class Meetings:

In-person attendance is strongly encouraged—and part of your grade. However, I do not want to encourage you to come to the classroom if you are sick, and I recognize that you may need to be away from the classroom from time to time. Therefore, I am willing to broadcast the meetings synchronously on Zoom for those who need this accommodation. The connection information is available on CourseSite. If you would like to participate remotely, you must ask for me for permission by 1 p.m. on the day of the meeting. I will only connect the meeting to Zoom if somebody has asked. Note that remote participation may provide a substandard experience in comparison to in-person participation: it may be difficult to hear statements, see gestures, or participate in discussions. As discussed in the attendance section, if you have a good excuse for attending via Zoom, I may give you full credit for remote attendance. But even if you don't have a good excuse, you can still attend remotely: in this case, you will not receive attendance credit, but you can still get points for participating in discussions. Please read the "Health" section at the end of this syllabus.

Grade Breakdown:

Your **midterm** grade will be determined as follows:

21%: Attendance

29%: Participation

14%: Essay

7%: Physics Homework

29%: Miscellaneous Pool

Your **final** grade will be determined as follows:

15%: Attendance

20%: Participation

10%: Essay

5%: Physics Homework

15%: Presentation

15%: Final Project

20%: Miscellaneous Pool

The attendance and participation components are discussed above. The remaining components are discussed below.

Essay:

I will ask you to write a paper on a topic to be announced later. This paper is worth 10% of your final grade.

Physics Homework:

Near the beginning of the semester, we will cover basic nuclear physics so you can understand some of the scientific issues discussed later in the course. I will assign some simple problems to gauge your mastery of this material. These problems are worth 5% of your final grade.

Presentation:

You will need to give one presentation of at least 10 minutes. Your presentation should be on a topic that interests you and is related to something we have studied (or will study) in class. You will need to do some independent research into your topic, and that research must go beyond reading a Wikipedia article. By default, your presentation will be a video that you produce and that your classmates will view and comment on (for participation points). If you are particularly interested in giving a live presentation in front of the class, please let me know. I am willing to consider collaborative projects between multiple students. So we don't have everybody turning in their videos at the same time, you will need to schedule your presentation with me in advance. Details will be announced. The presentation is worth 15% of your final grade.

Final Project:

Near the end of the semester, you will need to complete a final project. This should be on a topic that interests you and is related to something we have studied in class. The exact form of the project is fairly open, although we must agree on it in advance. You could write a research paper, watch and analyze a film, give another presentation to the class, stage a debate, write a short play, create a work of art, or something else not listed here. I am willing to consider collaborative projects between multiple students. It may even be possible to collaborate with students in other first-year seminars, although this is contingent upon the agreement of all professors concerned. The final project is worth 15% of your final grade.

Note that the Presentation and the final Project are two distinct grade items, and you must do both of them! The topics of the two may be related, but they cannot be the same.

Miscellaneous Pool:

Finally, 20% of your final grade will consist of miscellaneous points from small assignments. A significant fraction of these points will be from Content Quizzes (see below). Other small assignments might include things like bringing a quote or an image to a discussion session, or writing a short response to some of your assigned reading, viewing, or listening.

Content Quizzes:

I will assign short automated online quizzes to verify that you have done the assigned reading/viewing/listening. In general, content quizzes will be due a few minutes before the start of the class meeting where the material will be discussed. Late content quizzes are not allowed and will receive no credit. You will have only one attempt to complete each content quiz. Each content quiz will be time-limited; the limit will be somewhere around 10–20 minutes and will be announced in the quiz description. I will be happy to grant extra time for students who have received this accommodation from the University. I request that you notify me as soon as possible of your intention to use this accommodation.

Late Penalties:

A late penalty will be assessed on work according to the following formula:

$$G = G_0\left(1 - \frac{L}{T}\right) \tag{1}$$

Where G_0 is your grade before the penalty. L is the exact amount of time the work is late and T is 3 days. G will be rounded up to the nearest integer. Negative G will be set to 0. Let's take your initial essay as an example: if your original grade is 91% and you turn in your work 1 day, 4 hours, and 12 minutes late, your grade will be

$G = 91\% \times \left(1 - \frac{28.2\text{ h}}{72\text{ h}}\right) = 55.36\%$ $\quad\rightarrow$ rounded to 56%.

Late content quizzes are not allowed and will receive no credit.

Computing Grades:

You can trust the grades that CourseSite records for each **individual** assignment. However, CourseSite does not know about the formulas discussed above, so do not trust CourseSite for combined scores (like the total number of points in the Miscellaneous Pool) or for your overall grade. CourseSite also does not allow me to enter grades greater than 100%. Therefore, when extra credit is possible, the denominator shown in CouseSite may be larger than it should be. (For example, consider an assignment that has 100 regular points possible, plus 10 points possible extra credit. The denominator listed on CourseSite would be 110, even though the percent grade for that assignment should really be calculated out of 100 points.

I will calculate your combined scores and average grades in my own spreadsheet. There will be a link on CourseSite to a Grade Calculator (a Google Sheet) that will apply the formulas discussed above and let you get an accurate calculation of your grade. Trust that instead of CourseSite's calculation. Note that the Grade Calculator will be populated with random grades to demonstrate how to use the sheet. Those are not your grades! You will need to download or copy the sheet and insert your own grades.

Grading Scale:

94–100 = A

90–93 = A–

87–89 = B+

84–86 = B

80–83 = B–

77–79 = C+

74–76 = C

70–73 = C–

67–69 = D+

64–66 = D

60–63 = D–

< 60 = F

I reserve the right to curve grades upward if the class average is too low.

There Is No Such Thing As a Stupid Question:

This is the most important rule of this class. There is also no such thing as a stupid answer. I want all of you to feel comfortable asking and answering questions in this course. Please don't hesitate. Remember: sometimes "stupid" questions are actually the smartest questions.

Communication:

I will try to respond to your messages promptly. But I make no promise that I will respond outside of normal working hours, on weekends or holidays, or less than 24 hours after I get your message. A faster response is a bonus, not a guarantee.

Please use the forum on CourseSite to ask any questions that may be of interest to the other students. A private email to the professor would ideally only be used for questions that are specific to you. If you send me a general question via private email, I will encourage you to post it to a forum instead. Of course, if you are a bit timid about asking questions publicly, I would be happy to post your question to one of the forums without your name attached.

Scheduling Appointments:

To reduce the amount of emailing I have to do, I ask that my students first try to schedule an appointment in my calendar. The link is near the top of our CourseSite page, or you can click here. You just need to choose a time that works for you and enter some information. Please specify whether you want to meet in-person or on Zoom. And yes, I want **you** to make that

choice! Otherwise, I have to spend time sending you an email about how we're going to meet. If you need a longer appointment, please book multiple consecutive 15-minute slots. If none of the available times work for you, then you can send me an email directly. The calendar does not allow appointments to be made on the same day, so you will need to email me in that case. When you email me, please include a variety of **specific times** when you would be available to meet.

Academic Honesty:

Cheating and plagiarism are not allowed and will be punished with appropriate sanctions. I may use software to detect plagiarism in your work.

The question of whether to allow AI in course work is complicated. Here are my default ground rules. I do not completely forbid the use of artificial intelligence to help you in your work, but it must be used appropriately. Using AI as a robot writing tutor or editor is OK. Using it to do your thinking for you is not OK and may be considered plagiarism. If you use artificial intelligence, you must append a **complete transcript** of all AI sessions that contributed to your work. This transcript will not count toward the character/word/page limits for your assignment. Use of AI without submitting a complete transcript may be considered plagiarism. You may use short quotes from AI, as you would from a human, as long as they are properly cited and a transcript is appended. You should not submit papers that are all quotes or paraphrases of AI responses. I may use software to detect AI contributions to your work. I may also restrict the use of AI for particular assignments. I may even require some contributions to be written by hand in the classroom. Also note that current AI services have big problems with making up "facts" or references. You are responsible for every statement in all work you turn in. If your AI helper makes something up, you are responsible for the false statement. And if your AI helper plagiarizes something and you present the work as your own, you are responsible for the plagiarism.

Academic Freedom and Respect:

We will be discussing a controversial topic. There is no One Correct Opinion in this course, and you should expect to be confronted with opinions that differ from yours. I expect you to respect the expression of differing opinions, just as I will respect your right to express opinions that differ from mine. Our guest speakers may express opinions that you disagree with; you are free to challenge them respectfully, although I reserve the right to cut the discussion short for time reasons. That being said, racism, xenophobia, antisemitism, islamophobia, homophobia, transphobia, and other forms of bigotry will not be tolerated. You can disagree with somebody and you can criticize their words or actions. But there is a difference between that and questioning their basic worth as a human being.

I expect you to use people's correct names and prononus throughout this course. If you make an honest mistake, apologize graciously and try to do better.

Content Warning:

This is not a happy topic and you may encounter words and/or images that could upset you. In particular, the limited series contains depictions of injuries, illness, suicide, and violence. I will make a good-faith effort to provide advance warning about content that I reasonably expect might be troublesome. However, I may miss something. I encourage you to let me know if there are particular things you would prefer to be warned about. Content warnings will be made available on a dedicated page on CourseSite. You do not have to read the content warnings if you do not wish to.

Health:

The COVID-19 emergency is over, but that disease and others are still with us. I expect you all to be good citizens and protect the health of your classmates, our guest speakers, and me. Wearing a mask is perfectly acceptable in class. I may choose to do so from time to time. But unless you are ill, masking is optional and I expect you all to **respect each other's personal masking choices**. However, I strongly request that you wear a mask if you are actively coughing or sneezing (even if it is not COVID). Please keep your mask on when you cough or sneeze. Any cough or sneeze not captured by a mask should be into your hands, elbow, etc. In short: please do not spray your classmates with your respiratory droplets! If you have COVID or some other nasty bug, I will be happy to allow remote attendance of class meetings.

Student Senate Statement on Academic Integrity:

We, the Lehigh University Student Senate, as the standing representative body of all undergraduates, reaffirm the duty and obligation of students to meet and uphold the highest principles and values of personal, moral and ethical conduct. As partners in our educational community, both students and faculty share the responsibility for promoting and helping to ensure an environment of academic integrity. As such, each student is expected to complete all academic course work in accordance to the standards set forth by the faculty and in compliance with the University's Code of Conduct.

The Principles of Our Equitable Community:

Lehigh University endorses The Principles of Our Equitable Community. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf

Accommodations for Students with Disabilities:

Lehigh University is committed to maintaining an equitable and inclusive community and welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact

Disability Support Services (DSS), provide documentation, and participate in an interactive review process. If the documentation supports a request for reasonable accommodations, DSS will provide students with a Letter of Accommodations. Students who are approved for accommodations at Lehigh should share this letter and discuss their accommodations and learning needs with instructors as early in the semester as possible. For more information or to request services, please contact Disability Support Services in person in Williams Hall, Suite 301, via phone at 610-758-4152, via email at indss@lehigh.edu, or online at

https://studentaffairs.lehigh.edu/disabilities .

My office and the classroom are on the 4th and 5th floors of Lewis Lab, respectively. Both rooms are accessible by elevator.

Lehigh University Policy on Harassment and Non-Discrimination:

Lehigh University upholds The Principles of Our Equitable Community and is committed to providing an educational, working, co-curricular, social, and living environment for all students, staff, faculty, trustees, contract workers, and visitors that is free from harassment and discrimination on the basis of age, color, disability, gender identity or expression, genetic information, marital or familial status, national or ethnic origin, race, religion, sex, sexual orientation, or veteran status. Such harassment or discrimination is unacceptable behavior and will not be tolerated. The University strongly encourages (and, depending upon the circumstances, may require) students, faculty, staff or visitors who experience or witness harassment or discrimination, or have information about harassment or discrimination in University programs or activities, to immediately report such conduct.

If you have questions about Lehigh's Policy on Harassment and Non-Discrimination or need to report harassment or discrimination, contact the Equal Opportunity Compliance Coordinator (Alumni Memorial Building / 610.758.3535 / eocc@lehigh.edu).

Tentative Schedule:

The following is a **tentative** schedule for the course. Modifications will be announced, but this document will not be changed. This schedule does not include due dates for many of your assignments, particularly the smaller ones. These will be announced when the work is assigned.

- **8/27:** class meeting
- **8/29:** class meeting
- 8/30–9/3: watch *Voices from Chernobyl*
- **9/3:** class meeting
- **9/5:** class meeting
- 9/6: deadline for scheduling your presentation
- 9/6–9/10: watch *Chernobyl* episode 1: "1:23:45", listen to corresponding podcast episode
- **9/10:** class meeting

- **9/12:** visit from the Lehigh Library
- 9/13–9/17: watch *Chernobyl* episode 2: "Please Remain Calm", and podcast
- **9/17:** class meeting
- **9/19:** class meeting
- 9/20–9/24: watch *Chernobyl* episode 3: "Open Wide, O Earth", and podcast
- **9/24:** class meeting
- **9/26:** guest lecture on the nuclear threat in Ukraine today (Prof. Dinissa Duvanova)
- 9/27: deadline to determine your final project
- 9/27–10/1: watch *Chernobyl* episode 4: "The Happiness of All Mankind", and podcast
- **10/1:** class meeting
- **10/3:** guest lecture on the biological effects of ionizing radiation (Dr. David Cassatt)
- 10/4: Essay due
- 10/4–10/8: watch *Chernobyl* episode 5: "Vichnaya Pamyat", and podcast
- **10/8:** visit from Center for Career and Professional Development
- **10/10:** guest lecture on climate change (Prof. Ben Felzer)
- 10/11: Midterm Grades due
- 10/11–10/15: read *Atoms and Ashes* "Preface: Stolen Fire", chapter 1: "White Ashes: Bikini Atoll"
- **10/15:** guest lecture on production design (Prof. Will Lowry)
- **10/17:** class meeting
- 10/18–10/22: read *Atoms and Ashes* chapter 2: "Northern Lights: Kyshtym"
- **10/22:** class meeting
- **10/24:** class meeting
- 10/25–10/29: read *Atoms and Ashes* chapter 3: "A Very English Fire: Windscale"
- **10/29:** class meeting
- **10/31:** guest lecture on theatrical makeup (Prof. Erica Hoelscher)
- 11/1–11/7: watch *Test*
- **11/5:** no class meeting: Civic Engagement Day
- **11/7:** guest lecture on the impact of nuclear devices on Russian literature (Prof. Mary Nicholas)
- 11/8–11/12: read *Atoms and Ashes* chapter 4: "Atoms for Peace: Three Mile Island"
- **11/12:** class meeting

- **11/14:** class meeting
- 11/15–11/19: read *Atoms and Ashes* chapter 6: "Nuclear Tsunami: Fukushima"
- **11/19:** guest lecture on *genbaku* literature (Prof. Paul Schalow)
- **11/21:** class meeting
- 11/22–12/3: read *Atoms and Ashes* chapter 5: "The Star of Apocalypse: Chernobyl" and "Afterword: What Comes Next?"
- **11/26:** no class meeting
- **11/28:** no class meeting: holiday
- **12/3:** class meeting
- **12/5:** class meeting
- 12/6: Final Project due