STUDY GUIDE

Energy and Security (NPRE 480 / GLBL 480 / PS 480)

Spring 2025

Prof. Leon Liebenberg

The global economy is shifting towards clean-energy solutions, thanks to economic and technological innovation and the need for energy security. We are witnessing a rapid growth of clean-energy technologies in various regions, driven by market and business factors, and aided by effective policies and social pressure.

The 5.2-GW pumped storage (or "water battery") facility being constructed in Kurnool, a remote, hilly district in the southern Indian state of Andhra Pradesh. The $3.5 billion project is part of the Greenko Group's efforts to bring clean energy to India. In 2017 the company also constructed the largest single-location solar farm, spread over 24 square kilometers (9 square miles), or about 3,500 soccer fields. Pumped storage hydroelectric systems are however becoming less reliable due to the negative impacts from climate change (droughts!) that are already under way. Regardless, the integration of this pumped storage scheme and the surrounding solar farm allows for the renewable energy sources (pumped water; solar) to have a much larger capacity factor on the grid.
Image credit: Bloomberg

NPRE 480: Energy and Security – Spring 2024

Instructor: Prof. Leon Liebenberg, Energy and Sustainability Engineering (EaSE) program, Department of Nuclear, Plasma & Radiological Engineering, 121 Talbot Laboratory, 104 S. Wright St., Urbana 61801.
(E-mail: leonl@illinois.edu; Tel: (217) 300-5496)

Lectures: We will meet at 12:30 p.m. – 1:50 p.m. on Tuesdays and Thursdays in Room 2035 of the Campus Instructional Facility, 1405 Springfield Ave., Urbana, IL 61801. Attendance is mandatory. If students registered for in-person classes, they are required to attend every lecture in person. Students who registered as online students are required to participate in every lecture via *Zoom*:

Please download and import the following iCalendar (.ics) files to your calendar system.

Weekly:
https://illinois.zoom.us/meeting/tZAufuihpz8sHdOczeomTwWjRmqSB5fIacG9/ics?icsToken=98tyKuGsrTIrE92Rth6ARpwIA4r4d_PxmCldgqdynwXgDC1ndTT8BO9TAZAqFvHR

Join Zoom Meeting: https://illinois.zoom.us/j/84391994677?pwd=SDhmV3Z2THY0ZlpnVFp6dk5MNEYyZz09

Meeting ID: 843 9199 4677
Password: 341616

Your participation in class discussions is essential to help ensure that you benefit maximally from this course. To help you review material, lectures will be recorded and placed on *Canvas* in the NPRE 480 folder.

Your queries: You may also submit queries or questions anytime via *Piazza*. Students are encouraged to view their classmates' questions and to participate in course discussions on *Piazza*.

Sign up at: https://piazza.com/illinois/spring2025/npre480

Private questions should be directed using the "Private" option on *Piazza*, else the whole class will see your query / request. The teaching assistant or the instructor will respond to your questions as soon as they can.

The teaching assistant and the instructor will attempt to address your queries promptly from Mondays to Fridays (9 a.m. – 5 p.m.) and less promptly after these hours or over weekends.

Instructor's office hour: Professor Liebenberg's office hours will be held online-only via Zoom on Thursdays from 3:00 p.m. to 3:50 p.m. (excluding holidays).

Join Zoom Meeting:

https://illinois.zoom.us/j/89833760805?pwd=K1gvL1RLeDB5bjBYNVFqYisrOFJTdz09
Meeting ID: 898 3376 0805
Password: 511839

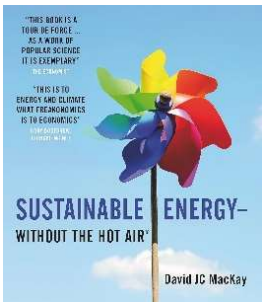
If office hours do not work for you, then you should send the instructor an email clearly stating your difficulty and attaching any relevant information (such as calculations). Allow a few days for the instructor to reply.
Please note that the instructor is also available for 10 minutes after every lecture to take your questions, directly outside of class.

Course webpage: Canvas website: https://canvas.illinois.edu/courses/54386

If you have difficulties accessing Canvas, then please contact consult@illinois.edu, *not* the instructor or TAs.

Course notes / slides: These will be made available on Canvas a few days before lectures. Notes completed during class will be posted on Canvas immediately after lectures.

Prescribed textbook:



1. "Global Energy Politics" by Thijs Van de Graaf and Benjamin Sovacool (Polity Press, 2020): $22 (e-book, paperback) - $75 (hardcover). Hardcover also available in Illini Union Bookstore.

Recommended reading:

2. "Sustainable Energy-without the hot air," by David MacKay (Bloomsbury Publishing, 2016), freely downloadable. Paperback available in Illini Union Bookstore.

Recommended reading: The following books which are available in the UIUC Library provide good background on many of the course topics. Do not purchase these books, but endeavor to peruse their content online.

1. "Energy Economics: Concepts, Issues, Markets and Governance" by Subhes C. Bhattacharyya.
2. "The Clean Energy Transition: Policies and Politics for a Zero-Carbon World" by Daniel Fiorino.
3. "Handbook of Transitions to Energy and Climate Security," edited by Robert E. Looney.
4. "The New Map. Energy, Climate, and the Clash of Nations" by Daniel Yergin.

Teaching Assistant ("TA") and Course Assistant ("CA"): Your TA will grade your assignments together with a course assistant (CA). You will be able to chat online (via *Piazza*) with your TA, **Ms. Silvana Tabares**, regarding difficulties that you might experience with assignments. The TA will, however, not help you to complete any assignments. You could also attend the TA office hours, as detailed below.

Ms. Silvana Tabares
tabares3@illinois.edu

Office hours: Thursdays, 3 – 4 p.m.

Join Zoom Meeting
https://illinois.zoom.us/j/82171340535?pwd=TzVnZ2p0azFHb2NqS0s1QVlLaWtLUT09

Meeting ID: 821 7134 0535
Password: 480

"Hi everyone, I am a PhD student in the NPRE department. My area of interest is computational physics, focused on neutronics and reactor core simulation and analysis. My favorite course I have taken so far is reactor theory, where I had the opportunity to develop my own neutron transport code. Do not hesitate to reach out if you have any questions!" – Silvana

Course Assistant (CA): Your course assistant (CA) is the top performer in NPRE 480 from Spring 2024, **Ms. Natalie Weissburg**. Natalie is a senior in Nuclear, Plasma, and Radiological Engineering and has acted as teaching assistant for numerous courses. She is also an undergraduate research assistant in the Center for Plasma and Material Interactions. Natalie is the Professional Development Chair for the *Women in Nuclear* Executive Board.

Ms. Natalie Weissburg
nweis3@illinois.edu

Grade appeal: Students have one week to appeal a grade after it has been published. After this period, the grades are final.

Course description: Energy insecurity takes distinct forms contingent upon the physical attributes of pivotal energy resources such as coal, oil, gas, nuclear, and renewables. In addition to appraising the capabilities and constraints of energy technologies, it is imperative to factor in the social, economic, and political landscapes that influence contemporary energy challenges across different temporal and spatial dimensions.

Consequently, this course is crafted to provide students with a strong foundation of intricate energy concepts, data, and interconnectedness. The course encompasses aspects like energy supply and demand, the nexus between energy and the environment, the relationship between energy and the economy, energy policy formulation, the intersection of energy and justice, governance in the realm of energy, and the landscape of energy technology and innovation. These components are intricately woven together to address the multifaceted dimensions of energy security.

The course consists of 14 weekly sessions, each with two 90-minute lectures. The lectures cover the theoretical and conceptual aspects of energy security. Guest speakers from the industry and entrepreneurship ecosystem may be invited to enhance practical insights. In-person students might also participate in an industry site visit.

The guided self-directed coursework is rooted in the practical application of key attributes associated with an entrepreneurial mindset, which is considered essential for navigating energy investment decisions and energy policymaking, for instance. These entrepreneurial qualities include mobilization, foresight, design under constraint, value identification, and simplification, among others. The incorporation of these attributes is thought to also enhance students' skills and attitudes, allowing them to maximize the value derived from their knowledge and ideas.

Students are expected to express their ideas through diverse mediums, including structured papers, narrative memos, high-impact fact sheets, infographics, and other modern technical communication tools. There will also be regular quizzes based on readings from the prescribed textbook and from the lecture notes.

Assessment

1. **Writing Assignments – individual (30% of grade):**
   - Based on course materials and class discussions.
   - Short case study analyses of real-world energy projects.
2. **Quizzes – individual (30% of grade):**
   - Based on readings from the prescribed book(s) and the lecture notes
3. **Class Participation Exercises – individual and team-based (10% of grade):**
   - Several classes will feature exrecises which students must complete in class, and which will be graded.
4. **Mini-project 1 – team (10% of grade):**
   - Submit your doodle summary of your chosen journal paper on energy security. Also submit the original (un-annotated) article in PDF format.
5. **Mini-project 2 – team (10% of grade):**
   - Submit a structured report of 1200 – 1500 words (approximately 4–6 pages) outlining your solutions, their feasibility, and their anticipated impact. Upload the report on Canvas as a high-resolution PDF document.
6. **Mini-project 3 – team (10% of grade):**
   - Submit your creative project (or a recording, or hyperlink, or PDF document, if applicable) alongside a 2–3-page summary explaining your work, its significance, and how it connects energy technology with societal, environmental, and economic considerations.

Artificial-intelligence searches can require 10 times the computing power of regular internet searches. Ready access to the vast amounts of electricity needed to keep AI data centers running is becoming a sustainability challenge for companies. Image credit: SeongJoon Cho/Bloomberg News

Syllabus (subject to change)

	For the class on …	… you should first study the following lecture notes at home,	… and you should read the following chapter from your textbooks.	Assignments (uploaded by 10 p.m. U.S. Central Time, unless otherwise specified)
1.	Tue. 21 Jan.	*Lecture Notes 1: Energy and Society* - Overview of Energy; Sustainable Energy; Energy Markets (Oil, gas, coal, uranium, renewables) - Entrepreneurial Opportunities in Energy Markets - Mobilizing Self and Others for Innovation - Case Study: House Equinox, Urbana	Graaf 1	Complete survey before Thursday 23 Jan. at 10 a.m.
	Thu. 23 Jan.		Graaf 1	
2.	Tue. 28 Jan.		Graaf 1, 2	
	Thu. 30 Jan.		MacKay 1, 2	
3.	Tue. 4 Feb.	*Lecture Notes 2: Energy and Security* - Energy statecraft; Resource wars; Nuclear proliferation; Geopolitics of energy transition - Motivation and Leadership in Energy Projects - Reducing Risks in Energy Technology Implementation - Case Study: Solar Farm 2.0	Graaf 3	Quiz 1
	Thu. 6 Feb.		Graaf 3	Writing assignment 1 "Electrifying the Modern Economy": (due by Thu. 6 Feb.)
4.	Tue. 11 Feb.		Graaf 3	
	Thu. 13 Feb.		MacKay 6	Mini-Project 1 is due by Thu. 13 February
5.	Tue. 18 Feb.	*Lecture Notes 3: Energy and the Economy* - Energy and the World Economy; the Energy Industry; Energy economics - Identifying Value Propositions in the Energy Sector - Action-Oriented Problem Solving in Economic Challenges - Case study: Wind Farm	Graaf 4	Quiz 2
	Thu. 20 Feb.		Graaf 4	
6.	Tue. 25 Feb.		Graaf 4	
	Thu. 27 Feb.		MacKay 4, 28	Guest views: Prof. Chris Tessum, "The energy-water-environment nexus"
7.	Tue. 4 Mar.	*Lecture Notes 4: Energy and the Environment* - Environmental impacts of energy; Fossil fuels; Global climate governance - Foresight in sustainable energy development - Case Study: Champaign-Urbana MTD Hydrogen Fuel Cell Buses program	Graaf 5	Quiz 3
	Thu. 6 Mar.		Graaf 5	Writing assignment 2: "Nurturing Change in the Nuclear Landscape" (due by Thu 6 Mar.)
8.	Tue. 11 Mar.		Graaf 5	Voluntary participation of visit to Abbott power plant (3 – 4 p.m.)
	Thu. 13 Mar.		MacKay 20	Guest views: Prof. Katy Huff, "The Future of Nuclear Power". (Moderated by Professors Leon Liebenberg and Jamie Jones)
9.	15 – 23 Mar.	SPRING BREAK		
10.	Tue. 25 Mar.	*Lecture Notes 5: Energy and Justice* - Energy deprivation; Energy, democracy, and human rights; Activists and social movements - Identifying opportunities for environmental justice - Case Study: UIUC Agrivoltaics pilot plant	Graaf 6	
	Thu. 27 Mar.		Graaf 6	
11.	Tue. 1 Apr.		Graaf 6	Quiz 4
	Thu. 3 Apr.		Graaf 6	Mini-Project 2 is due by Thu. 3 April Guest views: Prof. Jeremy Guest, "A circular bioeconomy"
12.	Tue. 8 Apr.	*Lecture Notes 6: Energy Technologies and Innovation* - The nature of technological innovation; Demand-side options; Supply-side options; Socio-technical barriers to change; Energy transitions; cost reduction through "learning"; market mechanisms. - Designing Under Constraint in Energy Innovation - Technological Opportunities and Entrepreneurial Solutions - Case Study: "Green cement," "Green steel," electric vehicles, advanced heat pumps	Graaf 7	Quiz 5 Voluntary participation of visit of Champaign-Urbana MTD solar-hydrogen fuel cell bus facilities. (3:00 – 3:50 p.m.)
	Thu. 10 Apr.		Graaf 7	Writing assignment 3: "Advancing Agrivoltaics - Investigating Energy Production" (due by Thu. 10 Apr.)
13.	Tue. 15 Apr.		Graaf 7	
	Thu. 17 Apr.		Graaf 7 MacKay 20, p. 62, pp. 322 - 326	Guest views: Mr. Frank Holcomb (US Army Corps of Engineers), "Geothermal energy".
14.	Tue. 22 Apr.	*Lecture Notes 7: Energy Policies and Regulation* - National energy governance; Energy policies in some countries; Multilateral energy governance; Transnational energy governance	Graaf 8	Quiz 6
	Thu. 24 Apr.		Graaf 8	
	Fri. 25 Apr. (3:00 – 3:50 p.m.)			

	For the class on …	… you should first study the following lecture notes at home,	… and you should read the following chapter from your textbooks.	Assignments (uploaded by 10 p.m. U.S. Central Time, unless otherwise specified)
15.	Tue. 29 Apr.	- Entrepreneurial Storytelling for Effective Communication - Entrepreneurial Approaches to Policy Advocacy - Case Study: Vogtle Nuclear Power Plants vs. Solar Farm 2.0	Graaf 9	Writing assignment 4: "Decarbonizing the steel industry" (due by Tue 29 Apr.)
	Thu. 1 May		Graaf 9 MacKay 24	Mini-Project 3 is due by Thu. 1 May
16.	Tue. 6 May	Showcasing the Mini-Projects - Team Projects: Applying Entrepreneurial Mindset to Energy Security Challenges - Designing for Implementation in Real-world Scenarios - Simplification and Innovation in Energy Solutions - Collaborative Presentations and Reflections		Quiz 7

Just two years ago, one in 25 cars sold globally was an electric vehicle. Specialists predict that in 2024 it will be one in five cars. In 2025, it will be one in two cars, and in 2030, three in four cars. And around 2040 there will be sharply reduced demand for oil from internal combustion engine vehicles worldwide.

Tesla vehicles at the company's Fremont, Calif., factory. Image credit: Noah Berger/Associated Press

MINI-PROJECTS (Team-based): *Climate Security and Energy Security*

Overview: In this series of three interconnected mini-projects, you and your selected (or assigned) teammate(s) will explore the intricate relationship between climate security and energy security. These assignments are designed to build progressively on one another, ensuring a cohesive flow of ideas throughout the projects. The ultimate aim is to investigate the interplay between urgent energy demands and long-term sustainability goals, addressing the misconception that energy security and climate action are mutually exclusive. Achieving sustainable energy requires a balance between both.

Team Formation: You have the option to form your own team or let the instructor assign one for you. This collaborative effort will enhance your ability to explore diverse perspectives and generate comprehensive solutions.

Context: The backdrop for this project is the ongoing energy crisis, which has shifted global priorities from reducing fossil fuel consumption to ensuring access to affordable and reliable energy. The challenge lies in bridging the gap between immediate energy demands and the necessity of adopting long-term sustainable practices, all while maintaining economic stability. This is particularly critical for developing nations, which must navigate these complexities amid diverse and pressing challenges.

NOTE: Below is only a summary of the projects; project details may be found in the *Mini Projects* folder on Canvas.

Mini-Project 1: Energy Security Insights: Doodle Summary of a Cutting-Edge Research Paper

Activity: In this mini-project, you will delve into the latest developments in the field of energy security by analyzing a high-impact journal paper from reputable sources such as *Energy Policy*, *Nature Energy*, or *Renewable Energy*. You may only select journals from the provided list, below. Your task is to create a "Doodle Summary" of the paper, where you will create a visually engaging and concise summary of the paper, emphasizing the key insights, challenges, and implications for energy security. Use visuals (e.g., charts, diagrams, drawings) and plain language to explain the content. The doodle summary should simplify the article's concepts while maintaining accuracy.

This foundational assignment will set the stage for subsequent mini projects by helping you identify key energy security challenges to address.

Mini-Project 2: Innovative Solutions and Implementation Strategies

Activity: Develop innovative solutions to address the challenges identified in your Mini-Project 1. Evaluate your solutions considering societal, technological, environmental, economic, and political dimensions. In addition, teams must identify potential obstacles and propose strategies to mitigate risks.

This project challenges you to think critically about the interplay between energy demands and sustainability goals and to develop actionable, forward-thinking strategies.

Mini-Project 3: Final Consolidation and Creative Communication

Activity: In Mini-Project 3, teams will consolidate their work from Mini-Projects 1 and 2 and communicate their findings in a high-impact and novel manner. Your deliverable should be of high-quality and good enough to be viewed by delegates attending the 2025 UN Climate Change Conference (UNFCCC COP 30) which will convene in November 2025 in Brazil.

This capstone project demonstrates your ability to synthesize knowledge, think innovatively, and communicate complex ideas in an impactful and accessible manner.

Renewable energy and energy security

Solar and wind are already the cheapest forms of new energy for 85% of the world and analysts expect their costs to continue falling, if trends continue, by another 25% to 50% by 2030.

Recent geopolitical tensions have prompted moves by Western governments to diversify supply chains in sensitive industries such as semiconductors and clean energy. The U.S.'s Inflation Reduction Act offers subsidies to encourage domestic manufacturing of electric vehicles, solar and wind-energy components. Tax credits are tied to local production requirements: EVs need to be assembled in North America to qualify for subsidies, for example.

Western Spirit wind turbines sit idle in a roadside field by Highway 54 in Torrence County, New Mexico. Image credit: The Wall Street Journal

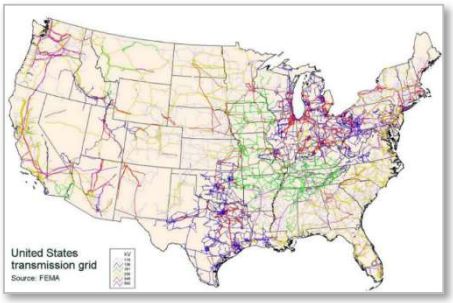
Installing solar panels at Adani Green Energy's Renewable Energy Park in India. Photo: Rafiq Maqbool/Associated Press

WRITING ASSIGNMENTS (Individual)

The writing assignments aim to foster self-directed learning, a vital skill for graduate students and professionals. Students need to study independently and demonstrate their expertise on the topics as they relate to energy security. NOTE: Below is only a summary of the projects; project details may be found in the Writing Assignments folder on Canvas.

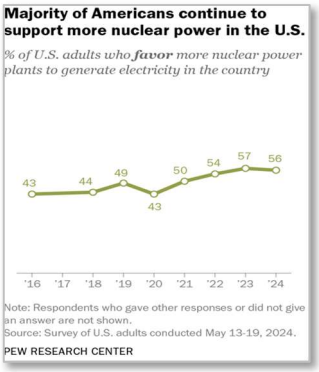
1. **<u>Writing Assignment 1</u> — Electrifying the Modern Economy (100 points)**

   Examine the feasibility of electrifying large portions of a modern economy within the context of the intricate US electricity grid. Discuss the challenges, opportunities (like micro-grids), and potential strategies for ensuring the stability of this expansive system. Report findings in a 500 to 800-word *essay*.



2. **<u>Writing assignment 2</u> — Nurturing Change in the Nuclear Landscape (120 points)**

   Compose a 500- to 800-word *fact sheet* that delves into the evolution of the nuclear safeguards system, highlighting the challenges posed by adversarial attitudes and proposing strategies for implementing constructive dialogue and positive safeguard action. Rigorous research on nuclear safeguards and a critical analysis of how societal and political attitudes can be transformed are essential components of this assignment.



3. **<u>Writing assignment 3</u> — Advancing Agrivoltaics - Investigating Energy Production (120 points)**

   Conduct an in-depth investigation into the energy production performance of agrivoltaic systems in various locations in the northern hemisphere. Assess and compare the energy production of a fixed-tilt photovoltaic array with a variable-tilt system, drawing insights from the paper "Impacts of location on designs and economics of DIY low-cost fixed-tilt open-source wood solar photovoltaic racking" by Vandewetering, N., Hayibo, K.S., and Pearce, J.M. (2022). Present your research findings in a high-impact *two-page fact sheet*. Report your findings in a high-impact fact sheet of no more than two pages.

Jack's Solar Farm. Image credit: Werner Slocum / National Renewable Energy Laboratory (NREL).

4. **<u>Writing assignment 4</u> — Decarbonizing the Steel Industry - A Sustainable Transition (140 points)**

   Produce a 4 to 6-page *narrative memo* detailing the traditional steel manufacturing process, introducing iron ore pyro-electrolysis as an alternative, and exploring the use of green hydrogen in this transition. Utilize explanatory diagrams and summaries of energy requirements and chemistry. Evaluate the environmental impact and align the findings with the urgency addressed in the UN's SDGs, supported by interpretations of at least five recent peer-reviewed journal papers.

Molten iron is poured into a furnace for purification and alloying to become steel at the ThyssenKrupp steelworks in Duisburg, Germany.

The International Energy Agency (IEA) has noted that the transition to clean energy will cost $12 trillion less than a "business as usual" scenario, which projects the economics of future energy demand and supply taking account of established and planned policies and regulations, but not more ambitious plans needed to achieve net-zero emissions.

When the IEA models those more ambitious pathways, capital costs to fund a shift to clean energy are sometimes higher in the near term. But continuing savings from avoided fuel costs fully support the investment, even in today's higher interest-rate environment. In short, saving the planet is cheaper than destroying it.

Ursula von der Leyen, president of the European Commission, unveiling the Green Deal Industrial Plan. The European Green Deal, Australia's Rewiring the Nation, and India's Green Hydrogen Mission are policy responses to the US's Inflation Reduction Act that are attempting to accelerate the pace of change and secure a portion of the prize for their own economies. Image credit: Valeria Mongelli/Bloomberg News

COURSE POLICIES

Late work: *Mini-project deliverables must be submitted on time so that the peer feedback process works properly*. There is no possibility of submitting a mini project late, nor is there the possibility of providing you with make-up assignments. Any late assignment or non-submission is awarded 0%.

a) To repeat, *there are no extensions for mini-project deliverables.* Teams have several weeks to plan and execute their work, so it's important not to leave tasks until the last moment. Teams should plan thoroughly and have contingencies in place to handle situations where a team member may be unable to contribute due to extenuating circumstances, such as illness.

b) Late quizzes or non-completion of class participation exercises will receive a 0% grade. Students will have around 6 days to complete each quiz, and solutions will be posted after the submission deadline passes.

c) No-penalty extensions for quiz or class participation due dates may however be granted by the instructor, but only if the student provides advance notice by email, except in emergencies. The *only* valid reasons for missing a quiz or class participation submission deadline are:

i. student illness or accidental injury;
ii. serious illness, serious injury, or death in the student's direct family;
iii. birth of a child for which the student is identified as a parent on the birth certificate;
iv. required duty in the U.S. military (active-duty, reserve, or in a National Guard unit activated by the President or a governor), required service in a foreign military organization acting in concert with the United States, or service under provisions of the Volunteer Emergency Worker Job Protection Act;
v. participation in, or travel to, an obligatory AFROTC, NROTC, or ROTC event;
vi. participation in, or travel to, varsity or DRES-sanctioned athletic events (excluding fencing, bowling, and other club sports);
vii. participation in, or travel to, an organized extracurricular activity sanctioned by the College of Engineering or one of its departments, for which a full-time or emeritus faculty member of the College of Engineering attests that the student's participation is essential;
viii. observance of a religious holiday;
ix. any excuse allowed by the UIUC for students participating in online learning.

If the student was so seriously ill or injured as to be unable to communicate their intentions to the instructor prior to the beginning submission deadline, the advance notification requirement will be waived if the student subsequently provides satisfactory documentation of such incapacitation.

In those cases where advance notification of lateness or non-submission has been provided, or where such notice has been waived according to the provisions of the second sentence of the above paragraph, late submissions of non-submissions will be classified as unexcused unless the student provides satisfactory after-the-fact documentation, as indicated below.

For illness or injury of the student, a satisfactory letter stating that the student was medically unfit to complete the quiz by the submission deadline must be provided by an appropriate medical practitioner (C.N.P., D.D.S., D.M.D., D.O., D.P.M., M.D., O.D., or P.A.) after the quiz submission deadline. *Medical bills, prescriptions, e-mail or letters from friends or relatives, letters from naturopaths, chiropractors, psychologists, and mental health counselors, "visit slips" from McKinley Health Center, and records of calls to McKinley Health Center's Dial-a-Nurse program (with or without endorsement by an "emergency dean" in the Office of the Dean of Students) are among the types of documentation that will not be accepted.*

For serious illness, serious injury, or death in the student's family, the student's relationship to the ill, injured, or deceased party must be established, along with documentation of the illness, injury, or death.

For birth of a student's child, a photocopy of an original birth certificate, showing the student as a parent, is required.

For military duty, copies of valid military orders are required.

For participation in or travel to varsity or DRES-sanctioned athletic events or AFROTC/NROTC/ROTC events, a satisfactory letter from the Division of Intercollegiate Athletics, DRES, or the commanding officer of the detachment is required.

For participation in, or travel to, an organized extracurricular activity sanctioned by the College of Engineering or one of its departments, a satisfactory letter from the faculty sponsor is required.

Independent work: You may collaborate with your classmates to figure out the necessary concepts and approaches, *but you must solve the problems independently*. See *Academic integrity* on page 13 of this study guide.

Teamwork: Effective teamwork requires empathy and respect. You should be willing and able to 'bend' your minds to recognize where others are coming from and what is important to them, and then to 'blend' with them, moving in a unified direction. You will learn techniques to be more receptive and connected, and to have greater influence whilst accommodating others. Rather than opposing or agreeing with other people, you will learn how to accept and acknowledge the other's position until you can understand what is important about it. This requires a willingness to flex, bend, and search to understand someone else's perspective. Once you understand their perspective, you can pivot and create an opening for that person to understand what is important to you.

Team members will communicate with each other using social media platforms of their own choosing. Historically, students enjoy collaborating using the following platforms: Discord, Zoom, Google Docs, WeChat, GroupMe, and Miro. You and your teammates should soon agree on your chosen method of online collaboration and then promptly get into that routine.

It is strongly suggested that teams use roving team leaders. For instance, a student could be team leader for the first mini-project, followed by another student leading the next mini-project, and yet another team member leading the third mini-project. This will help ensure that no single person dominates the team's actions.

Assigned team members will remain unchanged for the duration of the semester. Teams should however note that they must accommodate late-registered students into their teams, as directed by the instructor or TA. Teams may also have to negotiate lost team members as some students might drop the course. So, although ideal team sizes are 3 students, this number might become less (i.e., 2 students) or perhaps even more (i.e., 4 students) per team; in these cases, small teams might have to merge with other small teams and/or large teams might have to be split. The instructor and TAs will do their utmost to minimally disrupt existing teams. The full cooperation of every student is expected when forming or changing teams.

Grading the work of large teams and small teams: When grading the mini-projects of small teams (say, with two team members), we expect the same quality (and correctness) of work compared to larger teams (say with four team members); but, for smaller teams we of course do not expect the same quantity of work than that of a larger team. Conversely, we expect the same quality of work from a large team compared to anyone else; however, we expect a greater quantity of work from a larger team than a smaller team.

Peer- and self-evaluations will be done in the middle and at the end of the semester. The purpose of these brief evaluations is to check that all students are contributing fairly and substantially to team-based activities. These peer evaluations provide an opportunity for your fellow team members to reflect on how the team activities are progressing and to reflect on how team functioning might be improved. The aggregate scores of these peer evaluations will be *directly used to correct all project-related grades.* For instance, if a team member's peers score his/her contribution to the team's efforts as 3.5/5 (i.e., 70%), then the specific student's *overall* mini-project grade will be adjusted by a 0.7 correction factor.

Uncooperative team members: In this engineering class, effective teamwork is paramount for successful collaboration and project completion. Students are encouraged to actively engage in open communication, share diverse perspectives, and contribute their unique skills to foster a collaborative and innovative environment. However, should any student fail to cooperate with their team or disrupt the collaborative process, appropriate measures will be taken, including intervention by the instructor, potential reassignment of team roles, and, if necessary, disciplinary actions in accordance with the class policies. This ensures a fair and conducive learning environment that promotes the development of both technical and interpersonal skills crucial for success in the field of engineering.

Communication etiquette: We welcome communications concerning possible errors, or constructive suggestions about the materials. Please do not contact us to request increases in your assigned grade, outside of errors in grading. All class communications will use your UI NetID email; do not use any alternate such as gmail.

If you believe that an assignment has been incorrectly graded, communicate this with the instructor within 5 working days after the assignment has been handed back to you. After that period, your assignment will not be regraded, and your grade will remain unchanged.

Most Valuable Players (MVPs): As mentioned, you should state all your queries via Piazza, not via email. Piazza is configured to allow any student to post anonymously to their classmates whenever they prefer. In each discussion thread, different anonymous posters are automatically differentiated with pseudonyms to avoid confusion. The instructor invites you all to help answer your classmate's Piazza questions. The course assistant and the instructor will keep track of each time a student suitably answers a fellow student's Piazza question. At the end of the semester, we will tally all the results to see which students consistently and significantly helped their fellow classmates the most. Those winning students will each receive a bump of 1% in their final grade! Those winning students will also win the "Most Valuable Player" certificates that will be awarded at the end of the semester. We encourage the students in our class to make the most of this opportunity. This helps you to learn from each other's understanding of the course and increase your grades! And, as you answer the questions posted by your fellow classmates, you will realize that it also betters your own understanding of any concept.

Note: When the course assistant or instructor award "good post" awards on Piazza, which will eventually be tallied to give us the MVPs, they will use the following criteria:

- Does the question or the answer clarify a technical (not class-administrative) issue which was vague or confusing in the class instructional materials (lecture announcements and syllabus)?
- Does the question or the answer demonstrate unique and thoughtful engagement with the course material?
- Is one student going out of their way to clarify something from the lecture to another student?
- Does reading what the student wrote make you excited to learn more about the energy systems?
- Other: (New justification which we can apply retroactively).

Final grade

At the end of the semester, letter grades are determined based on composite numerical scores, weighted as previously described. The instructor does not have a predetermined "target" grade distribution, and it may vary significantly from semester to semester. Additionally, there is no "curving" of grades in this class.

Grades will be rounded up to the nearest whole number. For example, a final grade of 93.2% will be rounded to 93%, while a final grade of 93.6% will be rounded to 94%.

Letter grades at semester's end

Grade meaning	Refined letter scale	Numerical scale of marks
Excellent	A+	97 to 100
	A	94 to <97
	A-	90 to <94
Good	B+	87 to <90
	B	84 to <87
	B-	80 to <84
Adequate	C+	77 to <80
	C	74 to <77
	C-	70 to <74
Marginal	D+	67 to <70
	D	64 to <67
	D-	60 to <64
Inadequate	F	<60

COURSE RULES

Teamwork: Effective teamwork requires empathy and respect. You should be willing and able to 'bend' your minds to recognize where others are coming from and what is important to them, and then to 'blend' with them, moving in a unified direction. You will learn techniques to be more receptive and connected, and to have greater influence whilst accommodating others. Rather than opposing or agreeing with other people, you will learn how to accept and acknowledge the other's position until you can understand what is important about it. This requires a willingness to flex, bend, and search to understand someone else's perspective. Once you understand their perspective, you can pivot and create an opening for that person to understand what is important to you.

Team members will communicate with each other using social media platforms of their own choosing. Historically, students enjoy collaborating using the following platforms: Discord, Zoom, Google Docs, WeChat, GroupMe, and Miro. You and your teammates should soon agree on your chosen method of online collaboration and then promptly get into that routine.

It is strongly suggested that teams use roving team leaders. For instance, a student could be team leader for the first mini-project, followed by another student leading the next mini-project, and yet another team member leading the third mini-project. This will help ensure that no single person dominates the team's actions.

Assigned team members will remain unchanged for the duration of the semester. Teams should however note that they must accommodate late-registered students into their teams, as directed by the instructor or TA. Teams may also have to negotiate lost team members as some students might drop the course. So, although ideal team sizes are 2 students, this number might become more (i.e., 3 students) depending on the number of students in class. In some cases, students joining the course late will be asked to merge with existing etams. The instructor and TAs will do their utmost to minimally disrupt existing teams. The full cooperation of every student is expected when forming or changing teams.

Grading the work of large teams and small teams: When grading the mini projects of small teams (say, with two team members), we expect the same quality (and correctness) of work compared to larger teams (say with three team members); but, for smaller teams we of course do not expect the same quantity of work than that of a larger team. Conversely, we expect the same quality of work from a large team compared to anyone else; however, we expect a greater quantity of work from a larger team than a smaller team.

Peer- and self-evaluations will be done in the middle and at the end of the semester. The purpose of these brief evaluations is to check that all students are contributing fairly and substantially to team-based activities. These peer evaluations provide an opportunity for your fellow team members to reflect on how the team activities are progressing and to reflect on how team functioning might be improved. The aggregate scores of these peer evaluations will be *directly used to correct all project-related grades.* For instance, if a team member's peers score his/her contribution to the team's efforts as 3.5/5 (i.e., 70%), then the specific student's *overall* mini-project grade will be adjusted by a 0.7 correction factor.

Uncooperative team members: In this class, effective teamwork is paramount for successful collaboration and project completion. Students are encouraged to actively engage in open communication, share diverse perspectives, and contribute their unique skills to foster a collaborative and innovative environment. However, should any student fail to cooperate with their team or disrupt the collaborative process, appropriate measures will be taken. These measures include intervention by the instructor, potential reassignment of team roles, and, if necessary, disciplinary actions in accordance with class and University policies. This ensures a fair and conducive learning environment that promotes the development of both technical and interpersonal skills crucial for success in the field of engineering.

Academic integrity

The highest academic integrity is expected. Academic violations will however be dealt with according to the UIUC Student Code, Article 1, Part 4. Violations will be reported to the College of Engineering. The recommended penalty will be either failure of the course, or dismissal for the M.Eng. program and separation from the College of Engineering or UIUC.

Specific comments about academic integrity

- All students are responsible to refrain from infractions of academic integrity, conduct that may lead to suspicion of such infractions, and conduct that aids other in such infractions. "I did not know" is not an excuse.
- The following are academic integrity infractions (http://www.provost.illinois.edu/academicintegrity/students):
  - ✓ Cheating: using or attempting to use unauthorized materials.
  - ✓ Plagiarism: representing the words, work, or ideas of another as your own.
  - ✓ Fabrication: falsification or invention of information, including citations.
  - ✓ Facilitating infractions of academic integrity, helping, or attempting to help another commit infraction.
  - ✓ Bribes, favors, and threats: actions intended to affect a grade or evaluation.
  - ✓ Academic interference: tampering, altering, or destroying educational material or depriving someone else of access to that material.
  - ✓ Note: All infractions are documented in the campus-wide FAIR database.

- If you have difficulty completing your classwork, you should consult the instructor by showing him evidence of your attempts to solve the specific problem/s. However, most lecture time has been set aside exactly for this type of activity; use it to your full advantage.
- Copying (in whole or in part) another student's (or team's) quiz, project work, or exam is not permitted. Copying solutions from web-based answer keys such as Chegg is an honor code violation.
- Be sure to follow the course and University regulations and course or assignment policies/instructions regarding the use of AI tools like ChatGPT, Bing, CoPilot, ChatSonic, or Jasper. When using AI, substantiate or validate all claims, findings, or insights by citing credible sources such as peer-reviewed journal articles. And double-check simulation results by doing your own hand calculations. Remember, AI is a probabilistic tool based on a large database and can make mistakes; avoid simply copying answers from an AI tool, as this could lead to regret.
- If you choose to discuss your work with a fellow student, it should be a discussion in which one teaches the other, or where both work to a mutual understanding. The discussion should however relate to general concepts and not address the specifics of the quiz questions.
- It is not acceptable to give a fellow student your completed project work or quiz or other assignment so that they can copy it. In such a case, both you and your fellow student will have committed an academic violation.
- It is also unacceptable to copy work from a student who completed the course previously.
- You should properly cite references and sources in your written reports. Cases of cheating or plagiarism will be handled severely.

  Also, be wary to correctly use quotation marks for sentences or important data that did not originate with you. Further, paraphrasing should be kept to a minimum. When used, the paraphrased section should be specifically identified by citing the original source. It is not sufficient to simply provide a list of references but not indicate where a specific quotation or paraphrase was employed. In addition, all sources should be fully cited. As is done in scientific and engineering literature, you should briefly acknowledge in writing any significant discussions or interactions you had regarding the work you are reporting on.
- Ignorance of academic integrity or uncertainty regarding the instructor's wishes are not justifiable reasons for academic violations. If you are uncertain of the instructor's wishes or intentions, you should consult with him *before* acting.

COLLEGE OF ENGINEERING STATEMENTS

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: wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: wecare.illinois.edu.

Community of Care: As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or http://odos.illinois.edu/community-ofcare/referral/). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe.

Further, we understand the impact that struggles with mental health can have on your experience at Illinois. Significant stress, strained relationships, anxiety, excessive worry, alcohol/drug problems, a loss of motivation, or problems with eating and/or sleeping can all interfere with optimal academic performance. We encourage all students to reach out to talk with someone, and we want to make sure you are aware that you can access mental health support at the Counseling Center (https://counselingcenter.illinois.edu/) or McKinley Health Center (https://mckinley.illinois.edu/).

Mental Health: Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois Urbana-Champaign offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services and specialized screenings which are covered through the Student Health Fee.

If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

Academic Integrity: The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://studentcode.illinois.edu/.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: https://studentcode.illinois.edu/article1/part4/1-401/. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Religious Observances*:* The Religious Observance Accommodation Request form is available at http://odos.illinois.edu/community-ofcare/resources/docs/Religious-ObservanceAccommodation-Request-Form.pdf. Submit the form to the instructor and to the Office of the Dean of Students (helpdean@illinois.edu) by the end of the second week of the course; in the case of exams or assignments scheduled after this period, students should submit the form to the instructor and to the Office of the Dean of Students as soon as possible.

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 https://www.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 https://registrar.illinois.edu/academic-records/ferpa/ for more information on FERPA.

Inclusion: The intent is to raise student and instructor awareness of the ongoing threat of bias and racism and of the need to take personal responsibility in creating an inclusive learning environment. 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) (https://bart.illinois.edu/). 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.

Emergency response recommendations can be found at the following website: http://police.illinois.edu/emergency-preparedness/. You are encouraged to review this website and the campus building floor plans website within the first 10 days of class. http://police.illinois.edu/emergencypreparedness/building-emergency-action-plans/

Enjoy the course!