SYLLABUS
ABE 436 - Renewable Energy Systems – Fall 2025

Instructor: Dr. Amir Malvandi, Room 332E, Agr. Engr Science Bldg (AESB),
Office Ph: 217-300-6065, email: amirm2@illinois.edu.
Office hours**:** 2:00-3:00 pm Friday, other times by appointment
TA: Seth Nazari, Email: snazari2@illinois.edu

Weekly meeting schedule:
Two 50-min lectures; one 2-hour discussion.
Lecture: 1:00 - 1:50 p.m. Wednesday & Friday, 208 AESB
Lab/Discussion: 1:00 - 2:50 p.m. Monday, 208 AESB
Credit: 3 hrs. for undergraduates; 4 hrs. for graduate students with additional term paper
Prerequisite: MATH 220; PHYS 211 or ME 300 or consent of instructor

Course description:

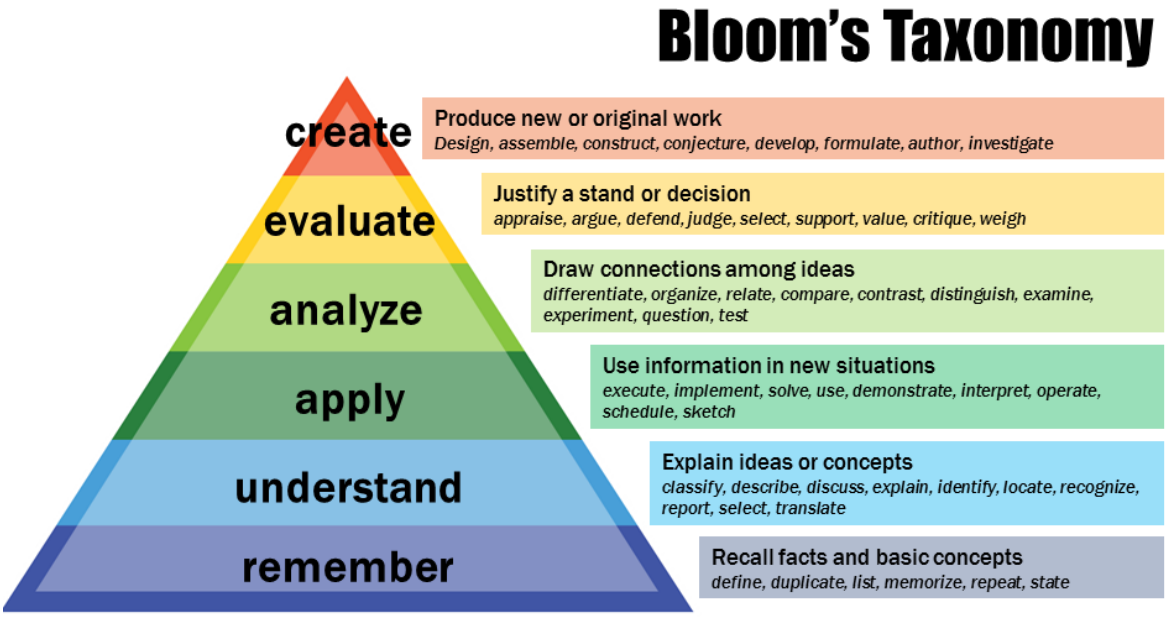
Renewable energy plays a vital role in environmental sustainability, economic growth, and the wellbeing and security of global communities. This course offers an in-depth exploration of the fundamental principles, technologies, and practical applications of various renewable energy systems. You will gain insights into solar, wind, hydroelectric, geothermal, and biomass energy systems, establishing a strong foundation for understanding and implementing these crucial technologies. Moreover, the course provides a comprehensive overview of key energy storage technologies, including pumped hydro, Compressed Air Energy Storage (CAES), and batteries. It also delves into the environmental impacts of energy conversion and how renewable sources contribute to mitigating air pollution and global climate change. The course culminates in a capstone group project that involves designing a system to capture and convert renewable energy into either thermal or electrical energy, applying the knowledge and skills acquired throughout the course.

Learning Outcomes:

Upon successful completion of this course, students will be equipped to:

- **Demonstrate** understanding of the different types of renewable energy technologies, including solar, geothermal, wind, and biomass, and how they are used to produce energy.
- **Show** comprehension of the opportunities and challenges in renewable energy systems.
- **Identify** the benefits and limitations of different renewable energy technologies in various contexts.
- Be **conversant** in debates and decision-making processes related to technologies such as wind, solar, geothermal, and bioenergy systems.
- **Evaluating** the performance and operations of various renewable energy technologies and recommending suitable renewable energy storage technologies.
- **Identify Energy Sources and Impacts**: Recognize different energy sources and understand their environmental and social impacts.

- Apply knowledge in **designing** renewable energy systems, while being **mindful** of pertinent constraints like public health, safety, welfare, and broader global and socio-economic factors.
- **Access Resources**: Learn to find and utilize relevant resources related to energy topics and issues.



Textbooks

**Renewable Energy System, Pressbook,(Under Production)*
**Renewable Energy: Power for a Sustainable Future.* 2018. Stephen Peake. 4th Edition, Oxford University Press
**Fundamentals and Applications of Renewable Energy.* 2023. Mehmet Kanoğlu, Yunus A. Çengel, John M. Cimbala, 2nd Edition, McGraw Hill

References

• *Renewable and Efficient Electric Power Systems*. 2013. Gilbert M. Masters. 2nd Edition, John Wiley & Sons, Inc. NJ.
• *The Physics of Energy*. 2018. Robert L. Jaffe and Washington Taylor. 1st edition, Cambridge University Press, Cambridge, United Kingdom.
• *Sustainable Energy: Choosing Among Options*. 2005. J. W. Tester et al., The MIT Press, Cambridge, MA.
• *Energy System Engineering: Evaluation & Implementation*. 2008. F.M. Vanek and L.D. Albright. The McGraw-Hill Inc. New York.
• *Renewable Energy: Its Physics, Engineering, Environmental Impacts, Economics & Planning*. 2004. Bent Sørensen. 3rd edition. ELSEVIER Academic Press.
• *Wind Energy Basics: A Guide to Small and Micro Wind System*. 1999. Paul Gipe. Chelsea Green Publishing Company, White River Junction, VT.

• *The Solar Electric House*. 1993. Steven J. Strong and William G. Scheller. Sustainability Press, Still River, MA.
• National Renewable Energy Laboratory (NREL)- http://www.nrel.gov/
• Office of Energy Efficiency and Renewable Energy (EERE)-http://www.eere.energy.gov/
• Handouts (provided by the instructor).

In-class participation

Class participation is an important aspect of student learning. When students ask questions, they learn how to obtain information to enhance their own understanding of a topic. When students speak up to answer questions in class, they learn to express their ideas in a way that others can understand. Each student is required to ask or answer at least 5 questions during the semester. **A self-assessment essay of participation is required**. I will meet individually with students whose self-assessment of their participation differs markedly from my assessment.

Quizzes

Quizzes serve as a means for students to reinforce their current understanding and ignite their curiosity in exploring new subject matter. Utilizing quizzes to assess students' comprehension is an efficient approach to reinforcing information retention.
Note: **There are a total of 5 quizzes. Your final grade will be determined based on the scores of the best 4 quizzes out of the total**.
Quizzes are conducted online, offering you three attempts to complete and review your score. The final grade considered will be the highest score attained across all three attempts.

Capstone group project

Each student is required to work in a team (4-5 students) to finish one case study on a system for collecting and converting renewable energy into thermal or electrical energy, or to design a renewable energy system. The topics can be anything interesting to them, such as
• Design of a wind farm for small community.
• Design of a solar energy system for a building or a house.
• Design of a geothermal energy system for a house.
• Design a system for converting biomass into biofuel, or thermal, or electrical energy.
• Enabling technologies to improve energy efficiency
• Other projects to improve energy efficiency

Labs and Discussions

Lab & discussion sessions are designed to provide students with activities that will enhance their understanding of the principles of renewable energy systems. Students are required to participate in discussions on the topics related to renewable energy utilization and environmental impact during the Lab/discussion sessions.

Term paper (graduate students only)

Graduate students are required to finish a literature review on the topic in renewable energy. At the end of the course, the student should submit a term paper and present the finding to the class. The term paper should include:
1. Background and goals of the research
2. Methodologies used by other researchers
3. Summary of the finding

4. Implications of findings to renewable energy and other related fields
5. Discussion of current status of technologies, challenges and future approaches

Homework and reports:

Homework and reports will be due ***two weeks*** after it is assigned. If you are unable to submit homework and reports by 11.59 p.m. on the due date, it is acceptable to seek permission from the instructor to extend the submission deadline. **Without this permission**, the homework will be deducted at 20% per day beyond the due date. No point will be given when key answers are posted, or previous homework is returned.

Note: **There are a total of 6 homework assignments. Among them, only the scores from the best 5 assignments will be taken into account for your final grade**.

Grading:

	Undergraduates	**Graduates**	**Only Online Section**
In-class participation	5%	5%	--
Quizzes	5%	5%	10%
Homeworks	30%	20%	20%
Lab/discussion reports	10%	10%	10%
Term paper	--	10%	10%
Capstone Group project	10%	10%	10%
Midterm exam	20%	20%	20%
Final exam	20%	20%	20%

We offer an additional 5% in bonus points for individuals who attend office hours (TA or Instructor) a minimum of two times.

Reference Grades:

A+ = 96% +	B+ = 84-87%	C+ = 72-75%	D = 60-64%
A = 91-95%	B = 80-83%	C = 69-72%	F = <60%
A- = 88-90%	B- = 76-79%	C- = 65-68%	

Welcome to the syllabus page for ABE 436. Here, you will discover a detailed roadmap that has been designed to guide you through the enriching learning journey that lies ahead. This syllabus acts as a guiding tool, providing lucid directions and valuable insights into the process of learning.

Daily Schedules (tentative):

Week	Date	Topic	Assignment
1	Aug. 25	Course Orientation; Energy and Outlook	
	Aug. 27	Energy and Environment	
	Aug. 29	Introduction to Renewable Energy Systems	
2	Sep. 1	**Labor Day**	
	Sep. 3	Solar Time, Angle, Tracking and Radiation	
	Sep. 5	Principles of Solar Thermal Energy	
3	Sep. 8	**Passive Solar House Design**	
	Sep. 10	Introduction to Solar Photovoltaics (PV)	
	Sep. 12	PV Efficiency and Performance	**Quiz 1 Due**
4	Sep. 15	**Solar Hot Water System Design**	
	Sep. 17	Solar PV systems	
	Sep. 19	Concentrated Solar Power (CSP) Technologies	**Lab1 Due**
5	Sep. 22	**Stand-alone PV System Design**	**HW 1 Due**
	Sep. 24	CSP Efficiency and examples	**Quiz 2 Due**
	Sep. 26	Economics and Environmental Impacts of Solar systems	
6	Sep. 29	**Grid-tied PV System Design**	**Lab2 Due**
	Oct. 1	Wind Energy Systems	
	Oct. 3	Wind Energy Basics: Wind Energy and Wind Resource	**HW 2 Due**
7	Oct. 6	**Design and Analysis of Wind Energy Systems (I)**	**Lab3 Due**
	Oct. 8	Power and Energy from Wind	
	Oct. 10	Principle of Wind Turbine	
8	Oct. 13	**Design and Analysis of Wind Energy Systems (II)**	**Lab4 Due**
	Oct. 15	Wind Turbines and Control	**Quiz 3 Due**
	Oct. 17	Control Systems in Wind Turbines	**HW 3 Due**
9	Oct. 20	**Review**	
	Oct. 22	*Guest Speaker from Agrivoltaic Systems or Bioenergy FARM tour*	
	Oct. 24	Economics and Environmental Impacts of Wind Turbines	**Lab5 Due**
10	Oct. 27	**Midterm Exam**	**HW 4 Due**
	Oct. 29	Geothermal Energy	

	Oct. 31	Geothermal Energy Utilization Technologies	
11	Nov. 3	**Field Trip to Solar Farm I or II**	
	Nov. 5	Ground source Heat Pump	
	Nov. 7	Economics and environmental impacts of Ground Source Heat Pump	
12	Nov. 10	**Bioenergy Sources**	
	Nov. 12	Utilization of Biomass (I) (**Yuanhui Zhang**)	
	Nov. 14	Utilization of Biomass (II)	
13	Nov. 17	**Discussion: Graduate Student Term Paper Presentation (I)**	**Quiz 4 Due HW 5 Due**
	Nov. 19	Utilization of Biomass (III)	
	Nov. 21	Carbon Capture, Utilization and Storage	
14	Nov. 22-30	**Fall and thanksgiving break**	
15	Dec. 1	**Discussion: Graduate Student Term Paper Presentation (II)**	**Quiz 5 Due**
	Dec. 3	Energy Storage systems	
	Dec. 5	Green building	
16	Dec. 8	**Discussion: Project Poster Presentation**	**HW 6 Due**
	Dec. 10	Review	
	TBD	**Final Examination date: 7pm-10pm**	

Mid Term Exam:

The mid-term exam will cover the introduction from week 1, as well as comprehensive topics on both wind and solar energy.

Final Exam:

Materials covered in the mid-term will be excluded from the final exam (Final exam will cover the remainder of the course following the mid-term.)

Attendance Policy (In person session):

Attending all scheduled classes, including lectures, discussions, and labs, is essential for your success in the course. However, situations may arise where you need to miss a class.

Planned Absences: If you have a religious observance, an athletic commitment, a graduate school interview, or any legitimate reason to miss a class, you must arrange to make up the missed work before the absence occurs. Otherwise, the absence will be considered unexcused, and you will receive a zero for the missed work.

Serious Illness/Family Emergency: In cases of serious illness or a family emergency preventing you from attending lab, please inform your TA via email and copy Dr. Malvandi.

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.

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 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)

If you are in immediate danger, call 911.
*This statement is approved by the University of Illinois Counseling Center

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-

of-care/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, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Student Assistance Center (SAC) in the Office of the Dean of Students for support and referrals to campus and/or community resources.

***Students with Disabilities*:** To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide the instructor with a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES). To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should apply for services with DRES and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail disability@illinois.edu or visit the DRES website at http://www.disability.illinois.edu/. Here is the direct link to apply for services at DRES, https://www.disability.illinois.edu/applying-services.

***Disruptive Behavior**:* Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (https://conflictresolution.illinois.edu; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

***Emergency Response Recommendations*:** Emergency response recommendations and campus building floor plans can be found at the following website: https://police.illinois.edu/em/run-hide-fight/. I encourage you to review this website within the first 10 days of class.

***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. Students should complete the Request for Accommodation for Religious ObservancesLinks to an external site. form should any instructors require an absence letter in order to manage the absence. In order to best facilitate

planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.

***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 and Disability Office. In turn, an individual with the Title IX and Disability 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.