
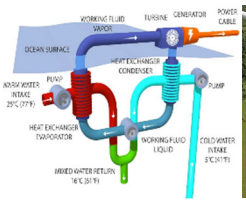




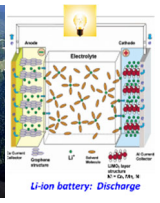

Renewable Energy Technology and Systems

EEE 498/591
Fall 2024

Course Objective
To introduce the basic concepts of energy systems, with a particular focus on renewable energy systems. The course will have an overview of energy systems, focusing on energy conversion processes and the different characteristics of energy conversion processes. The course will cover the basic operation and design of solar thermal, photovoltaics, wind, hydroelectric, biomass, and other renewable technologies such as wave energy, tidal energy, and ocean thermal energy conversion (OTEC). The integration of renewable energy into the existing energy infrastructure, barriers to deployment, and cost-effectiveness will also be major areas of focus.

Course Outcomes
1. Basic understanding of energy systems, energy conversion and energy transport
2. Basic understanding and ability to perform energy resource calculations of solar and wind energy
3. An understanding of the fundamentals, operation, uses and advantages/disadvantages of the major renewable energy technologies
4. Design principles of renewable energy systems and the integration of renewables into existing energy systems

Prerequisites
Junior/senior standing in electrical engineering, physics, materials science, chemistry, mechanical engineering, or similar field. This means having taken the required prerequisite math, physics and chemistry courses for these fields. Some introductory experience with physical principles of energy, power, and electrical circuits.

Instructor Prof. Richard R. King, Engineering Research Center (ERC) 177

Contact Information
email: richard.r.king@asu.edu
phone: 805-558-4576

Class Schedule and Location
Tu Th 9:00-10:15 am
ECG Room G335

Credits 3 credits

Required Textbooks

1. Stephen Peake, *Renewable Energy: Power for a Sustainable Future, 4th Ed.*, Oxford University Press, ISBN: 978-0-1987-5975-1.

2. Charles F. Kutscher, Jana B. Milford, and Frank Kreith, *Principles of Sustainable Energy Systems, 3rd Ed.* (2019, CRC Press, Taylor & Francis Group, Boca Raton, FL), ISBN: 978-1-4987-8892-2.

Reading The reading assignments from the textbook and the corresponding video lectures and examples are posted on Canvas for each week of the semester.

Office Hours

The office hours for this class will be held via Zoom teleconference, using the Zoom link below:

https://asu.zoom.us/j/87878568916?pwd=MVo2NGQrRjZUVXpMek8xTzVFeFYyZz09

Password: solarisfun

Office hours will be held for 2 hours/week, and office hour days and times will be announced in class and on Canvas. For meetings outside regular office hours, you can also reach me by email and I will try to respond as promptly as possible.

Community Forum

This course uses the **Discussions** forum on Canvas, an online discussion forum which you can find in the main menu on the left hand side of the screen in Canvas. Here you can ask questions and share your understanding about the course, work together on homework, etc. As always the homework you submit must be your own work, but you are encouraged to discuss the homework with others in the class and to work together in groups to discuss the concepts and approaches for solving the problems.

Questions for the instructor

To reach the instructor for questions, please use email rather than Canvas messaging or other messaging options. Sending your message by email will make it easier to reply to your questions.

For questions on homework or general class questions, first try discussing them with your classmates in study groups or on the Discussions forum (see above). You're encouraged to help explain concepts and discuss homework problems with your classmates. Note however that the work you turn in must be solely your own.

Email ASU email is an official means of communication among students, faculty, and staff. Students are expected to read and act upon email in a timely fashion. Students bear the responsibility of missed messages and should check their ASU-assigned email regularly.

Homework Assignments will be posted, received and returned on Canvas. Late homework will not be graded. The homework submitted online must fulfill the following requirements:

- Write your assignment clearly.
- Write your assignment on plain white paper, leave a 1 inch margin.
- Write your name, student ID, and the assignment number clearly on the first page of the document. Number each page.
- Scan your assignment in black & white, use an 8 megapixel camera or a 300 dpi scanner. If you use a camera phone, install an app that collets all the images in a PDF document and corrects the perspective.
- Check the readability of your document before uploading it.
- Upload the assignment as one multi-page PDF file.

Computers Use of software (*e.g.*, MathCad, Matlab, Mathematica, Python, Spreadsheet, TK Solver, etc.) to solve homework problems makes life easier for you and if you do not know such programs it helps you to learn them!

Midterm Exam(s)

The midterm exam date or dates will be announced in class about one week beforehand.

Final Exam **Finals week Dec. 9 - 14, 2024**
Please check ASU Final Exam Schedule at:
https://students.asu.edu/final-exam-schedule
to confirm this time and date.

All material presented during the semester may appear on exams, quizzes, assignments, and tutorials unless otherwise noted.

For legitimate and exceptional circumstances, determined by the instructor, the score of one or more exam/assignment/tutorial may be used to replace the score of another exam/assignment/tutorial.

For undergraduate version of class, EEE 498:

Grading	Homework	25%
	Class participation/activities	10%
	Exams, incl. Final exam	65%
	Total	100%

For graduate version of class, EEE 591:

Term Paper The graduate version of the class has an additional requirement of a polished, 5-8 page term paper, which is a review or a modeling study of a specific aspect of renewable energy technology. The term paper will be developed throughout the semester with an outline, a draft paper, and the final term paper due before the final exam.

Grading	Homework	25%
	Class participation/activities	10%
	Term paper	10%
	Exams, incl. Final exam	55%
	Total	100%

Tentative Course Outline

Section 1: Energy and Power Basics and Overview (2 weeks) (Chap. 1 and 2)

- Definitions, units and conversions.
- Fundamental types of energy: heat, chemical, radiative, potential, kinetic, nuclear.
- Energy conversion: thermodynamics
- Energy flows: conduction, convection, radiative, insulation.
- Energy usage: electricity-heating, cooling, lighting; fuels: transportation, heat
- Issues in energy systems: technical, economics, sustainability, climate change
- Renewable energy sources: overview

Section 2: Solar-Based Processes (4 weeks) (Chap. 3 and 4)

- Solar resource: solar models, radiation on the earth, variation of solar radiation
- Solar thermal fundamentals
- Solar thermal for heating (water, air), active and passive solar, heat pumps
- Solar thermal for electricity: concentrating solar power, steam turbines, efficiency
- Photovoltaics (PV): basic operation, technologies, modules, system components, loads, applications, PV systems, design

Section 3: Wind Systems (2 weeks) (Chap. 8)

- Wind resource: sources, global and local resources, measurement
- Power from wind turbines: power curve, measured resource data
- Operation of wind turbines: blades, aerodynamics, wind turbine components

Section 4: Water-Based Systems (2 weeks) (Chap. 6-7, 9)

- Hydropower: principles, turbines, dam structures, pumped hydro, impacts
- Ocean power: wave (tidal), OTEC

Section 5: Bioenergy: (2 weeks) (Chap. 5)

- Biomass
- Algae

Section 6: Storage: 2 weeks (Chap. 11, notes)

- Batteries
- Fuel Cells
- Other storage: pumped hydro, compressed air, etc.

Section 7: Grid Integration of Renewables 2 weeks (Chap. 11, notes)

- Electrical grid: generation, transmission, distribution, loads, EVs
- Effects of renewable energy intermittencies, role of storage
- Regulation and public policy
- Renewable energy futures