

ECE 618-852 Renewable Energy Systems

Course Description:

The online course primarily explores the basic concepts, operating principles, potentials, and limitations of photovoltaic devices (i.e., solar cells) as one of the most important renewable energy systems for efficiently converting solar energy into electricity. Also briefly discussed toward the end of the course will be the battery technology as an important energy storage system.

Prerequisite: Undergraduate solid-state physics or semiconductor devices

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Course Textbook: (1) Applied Photovoltaics by SR Wenham, MA Green, ME Watt, R Corkish, 2nd Edition, Earthscan publishing, 2007; (2) Lecture notes

Supplementary Course Material: (1) <http://pveducation.org/>; (2) Solar Cells: Operating Principles, Technology, and System Applications, M. A. Green, Prentice-Hall, 1981

Course Learning Outcomes: Students will learn the fundamental background of solar energy and gain an understanding of physics, engineering, and design principles of solar cells and current state-of-the-art approaches

Topics:

- Lecture 1: Basics of solar energy (solar spectrum, characteristics of light)
- Lecture 2: Properties of solar irradiation
- Lecture 3: Solar energy converters and quantum mechanics
- Lecture 4: Semiconductor band theory
- Lecture 5: Device physics of Si p-n junction solar cells, dark characteristics
- Lecture 6: Optical absorption and charge separation, Shockley-Queisser limit of solar cells
- Lecture 7: Physics of organic semiconductors
- Lecture 8: Operation principles of organic solar cells
- Lecture 9: Organic bulk heterojunction and hybrid perovskite solar cells
- Lecture 10: Inorganic multi-junction solar cells
- Lecture 11: Concentrator photovoltaic systems and rechargeable batteries
- Lecture 12: Special topic (TBA)

Grading Policy:

- Midterm exam: 35%
- Final Exam: 35%
- Online Quiz: 30%
- All exams will be done remotely; on a determined date & time, the exam file will be sent to you via email, and you will be given a time window during which each person's solved exam should be returned via email. More details will be announced as exam dates approach.