It is now a common sense that solar energy will become the main source of energy solely based on economics. The price of solar cells is already so low that it is the least expensive source of electricity in most part of the world. Owing to large-scale mass production, the manufacturing cost of solar cells will be reduced further. Solar thermal application is undergoing a significant transition, and will be in even more widespread use. Because solar radiation is intermittent, to make solar energy the main source, energy storage is a major issue.

The course covers the physics of solar energy as the scientific background of its exploration in a logical and unified way, focused on issues with practical significance, including detailed descriptions of many actual devices. It is organized in 24 75-minute lectures (MW 1:10-2:25 pm). It requires two exams and a term paper. The content is divided into 13 chapters. The number following the chapter title indicates the number of lectures for that chapter.

Prerequisite: general physics (PHYS C1401x, C1402y, C1403x, C1601x, and C1602y), freshman mathematics including ordinary differential equations and complex numbers (MATH V1201 and V1202, E1210x or y). Familiarity in thermodynamics, electromagnetism, quantum mechanics, solid-state physics and electronic device physics is preferred.

Textbook


List of Chapters

Chapter 1: Introduction (3)

Chapter 2: Nature of Solar radiation (3)


Chapter 3: Origin of Solar Energy (1)


Chapter 4: Tracking sunlight (3)


Chapter 5: Interaction of sunlight with Earth (2)

Interaction of radiation with matter. Interaction of sunlight with atmosphere: The AM1.5 solar spectral irradiance. Storage of solar energy in the ground: the shallow geothermal energy.

Chapter 6: Thermodynamics of solar energy (2)


Chapter 7: Quantum transitions (1)


Chapter 8: pn-Junction (1)

p-type and n-type semiconductors. Formation of a pn-junction. Analysis of pn-junctions. The Shockley equation.

Chapter 9: Semiconductor solar cells (3)


Chapter 10: Solar Photochemistry (1)

Chapter 11: Solar Thermal Energy (2)


Chapter 12: Energy storage (1)


Chapter 13: Building with Sunshine (1)


Schedule of Lectures and Exams


Lecture 9: October 2. Treatment in solar time. Treatment in standard time.


October 16: Midterm exam. Topic of term paper finalized


Lecture 24: December 4 Building with Sunshine. Homework 12.

December 9 - 11: Review for final exam. Term paper due.

December 13 - 20: Final exam (exact date will be published by registrar).

**Grading policy**

The final grade is based on the accumulated points (maximum points 100). There are 12 sets of homework. Each homework set is due a week from the date of issuing. Each homework counts for 3 points, with a total of 36 points. The midterm exam counts for 20 points. The final exam counts for 30 points. Term paper counts for 14 points.

Both midterm exam and final exam are closed book. For both exams, a calculator is required. No computers and smart phones.