APHY 420 Solar Thermal Systems

Catalog Description

Physics of the solar energy resource, solar collection, concentration, thermal conversion, energy storage, and the design and performance of solar thermal energy systems. (3 credit hours)

Course Objectives

Course objectives include learning:

About the nature, quality and quantity of the solar radiation resource and about methods to predict the amounts of solar energy incident on a solar collector;

How to analyze the optical and thermal performance of solar collectors and concentrators;

How to describe and model the various methods for transporting and storing thermal energy;

About the characterization and measures of end loads;

About solar energy system design and performance modeling.

Course Rationale

The depletion of fossil energy resources and the need for environmentally benign energy sources will result in increased world reliance on solar energy in its various forms. Supplying thermal energy in various temperature regimes for a myriad of tasks and processes is a primary end use of our energy resources. The collection of solar energy, its conversion to thermal energy, thermal energy transport, and the end uses of that energy are the topics of this course.

Course Content, Format, and Bibliography

Content

Introduction: energy statistics, exponential growth, conservation

Solar radiation

Radiation characteristics of opaque and transparent materials

Selected topics in heat transfer

Methods for solar collection: concentrating and non-concentrating collectors

Active solar thermal systems

Theory of flat plate collectors
Flat plate collector performance
Concentrating collectors
Solar thermal process loads
Thermal energy transfer and storage
Component thermal calculations
System modeling, design and analysis
Solar water heating
Solar space heating
Industrial process heating
Solar cooling systems
Passive solar thermal systems
Basic types and components
Design patterns
Direct gain, storage wall, greenhouse, and other systems
Thermal loads
Thermal energy transfer and storage
Component thermal calculations
System modeling, design and analysis
Solar water heating
Solar space heating
Solar cooling systems

Format
Several teaching methods are used in this course to achieve the course objectives. Some descriptors of these methods include lecture, peer instruction, cooperative problem-solving, class discussions of conceptual questions and technology applications, live demonstrations, computer simulations, video clips and programs, and hands-on laboratory experimentation in a team format. These methods provide a range of pedagogical opportunities for students to achieve the course objectives.
This course is taught as a dual undergraduate/graduate course. Students will be required to complete activities appropriate for the level of the course in which they are enrolled. Student performance on homework, exams and/or labs will be evaluated using different standards for undergraduate and graduate students.

**Bibliography**


