

Prepared by the Department of Natural Sciences & Life Fitness
Date of Departmental Approval: February 15, 2017
Date Approved by Curriculum and Programs: March 1, 2017

Effective: Fall 2017

1. Course Number: ENV173
Course Title: Introduction to Solar Energy

2. Description: Students in this course gain an understanding of the solar energy resource and how it can be utilized for a variety of energy demand applications in residential, commercial, and municipal buildings. The benefits and limitations of various solar energy technologies that are commonly used to produce heat, hot water, and electricity are examined. Students learn how to properly site, size, design, and specify solar hot water and solar electric systems. Students also learn how to perform an economic and environmental analysis of proposed systems.

3. Student Learning Outcomes (instructional objectives; intellectual skills):

Upon successful completion of this course, students are able to do the following:

- Describe and quantify the solar resource.
- Explain what factors influence the availability of solar energy at different locations across the globe.
- Differentiate between the main categories of solar energy technologies (passive thermal, solar hot water, photovoltaic, and concentrating solar power) and explain which technologies work best for different applications.
- Conduct a site assessment to determine amount of solar irradiation at a particular location.
- Describe the main principals of passive solar design.
- Properly site and orient a building to optimize solar gain.
- Explain the benefits and limitations of different types of active solar thermal and photovoltaic systems.
- Describe markets and applications for solar thermal and photovoltaic systems.
- Identify types of solar thermal and photovoltaic systems.
- Describe the thermodynamics principals at work in active solar thermal systems.
- Explain how solar cells convert sunlight into electricity.
- Calculate load demand for stand alone and grid connected electricity.
- Identify various types of photovoltaic cells.
- Describe the typical components and construction of a photovoltaic module.
- Properly size a solar thermal system to meet the energy needs of various applications.
- Properly size a photovoltaic system to meet loads of on and off grid applications.
- Calculate the energy output, fuel savings, and emission reductions of solar thermal and photovoltaic systems.
- Calculate and explain the economics of solar thermal and photovoltaic systems.

4. Credits: 3 credits

5. Satisfies General Education Requirement: No

6. Prerequisites: MAT020 (Prealgebra) or MAT025 (Pre-Algebra) and ENL108 (Critical Reading & Thinking) or satisfactory basic skills assessment scores

7. Semester Offered: Spring

8. Suggested General Guidelines for Evaluation: Tests, design projects, homework assignments, and a final exam are used to evaluate students.

9. General Topical Outline (Optional):

I. Introduction & Background Information

- A. Basic energy concepts, terms, and units
- B. Overview of energy use by sector
- C. Understanding and quantifying the solar resource
- D. Characteristics of sunlight
- E. Earth, Sun, and the Seasons
- F. Finding Solar South

G. Using the Solar Pathfinder

II. Passive Solar Thermal

- A. Basic thermodynamics concepts
- B. Principals of Passive Solar Design
 - a. Solar heating & cooling basics
 - b. Site orientation
 - c. Window placement
 - d. Building envelope (insulation, vapor barriers...)
 - e. Introduction to thermal mass
 - f. Ventilation
 - g. Daylighting

III. Active Solar Thermal

- A. Basic thermodynamics concepts
- B. History of active solar thermal
- C. Solar thermal technologies
 - a. The flat plate collector
 - b. Evacuated tube collectors
 - c. Batch collectors, pool heaters, building integrated, and others
- D. Types of solar thermal systems (batch, drain back, closed loop...)
- E. Applications
 - a. Domestic hot water
 - b. Space heating
 - c. Pool heating
- F. Major components of solar thermal systems
- G. System sizing, configurations, and layout
- H. Overview of installation and system integration techniques
- I. Conducting a solar thermal site visit
- J. Economic and environmental assessment
- K. Additional solar thermal technologies (electricity production, refrigeration, heat pumps, direct air heaters, cookers, etc.)

IV. Photovoltaics

- A. History of PV
- B. Basic electricity concepts
- C. How PV cells work
- D. PV Applications (remote, residential, commercial, ...)
- E. Types of PV cells & PV production techniques (single crystalline, multi-crystalline, amorphous, ...)
- F. Types of PV systems (stand alone, grid tied, single purpose,..)
- G. Major components of photovoltaic systems (Inverters, batteries, charge controllers...)
- H. Conducting a PV site visit
- I. On and off grid load analysis and system sizing
- J. System layout, configuration, and design
- K. Economic & environmental assessment