ENSC M07: APPLIED SOLAR TECHNOLOGY

Originator
bswartz

Co-Contributor(s)

Name(s)
Putnam, Roger (rputnam)

College
Moorpark College

Discipline (CB01A)
ENSC - Environmental Science

Course Number (CB01B)
M07

Course Title (CB02)
Applied Solar Technology

Banner/Short Title
Applied Solar Technology

Credit Type
Credit

Start Term
Fall 2023

Catalog Course Description
Surveys the fundamentals of solar technology and photovoltaic systems with a focus on design, installation, and maintenance. Emphasizes mechanical and electrical integration, system sizing, array layout, mounting, related electric codes, workplace safety standards, and troubleshooting.

Taxonomy of Programs (TOP) Code (CB03)
0303.00 - *Environmental Technology

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
B (Transferable to CSU only)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
C - Clearly Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
May be required

Faculty notes on field trips; include possible destinations or other pertinent information
May include trips to facilities powered by solar PV such as the "solar village" on Moorpark College's campus.

Grading method
(L) Letter Graded

Alternate grading methods
(O) Student Option- Letter/Pass
(P) Pass/No Pass Grading

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
52.5
Maximum Contact/In-Class Lecture Hours
52.5

Activity

Laboratory

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
52.5
Total Maximum Contact/In-Class Hours
52.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
105
Maximum Outside-of-Class Hours
105

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
157.5
Total Maximum Student Learning Hours
157.5

Minimum Units (CB07)
3
Maximum Units (CB06)
3

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	prepare a sample proposal for a complete solar thermal water heating system for a residential or commercial project.
2	prepare a sample proposal for a complete photovoltaic system for a residential or commercial project.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	define basic solar terms (e.g., irradiation, Langley, azimuth), describe solar movement and the effect of earth's tilt, predict solar position using a solar path diagram or sun chart, and determine true (solar) south from magnetic (compass) south given a declination map; examine, evaluate, and identify the potential implementation of solar technology and identify types of photovoltaic systems.
2	explain the difference between energy and power and compare and contrast the power and energy consumption of common electrical appliances in the home and business; describe how a solar cell converts sunlight into electric power.
3	outline the proper safety procedures, precautions, and protective equipment used to mitigate hazards in photovoltaic systems (both operational and non-operational) during installation and maintenance.

4	diagnose electric services and distribution panels for sufficient capacity to add grid-connected and stand-alone photovoltaic systems per national electric code and local standards.
5	analyze ground, roof, and pole constructions and their effects on photovoltaic system design and mounting.
6	evaluate array, battery, and inverter size for grid-connected and stand-alone systems, calculate approximated peak power output (AC and DC), and estimate monthly and annual energy outputs.
7	illustrate the effects of environmental conditions and series/parallel connections on current-voltage (IV) curves; solve simple series and parallel electrical circuit problems.
8	assess photovoltaic system configuration options using web-based and stand-alone software sizing tools.
9	describe the mechanical loads on a photovoltaic array (e.g., wind, snow, seismic, etc).
10	list and describe the purpose and operation of main electrical balance of system (BOS) components.
11	identify common adaptations to the electrical and mechanical design of photovoltaic systems for site-specific environmental constraints to satisfy local codes and standards.
12	troubleshoot for common issues that lead to typical photovoltaic system performance problems; demonstrate an awareness of potential electrical and mechanical failures and propose alternative remedies.
13	evaluate key features, costs, and benefits associated with each step of photovoltaic systems with consideration of utility and government incentives.

Course Content

Lecture/Course Content

- 12.00% Energy and photovoltaic principles
- 10.00% Safety requirements and procedures
- 12.00% Electrical principles and residential wiring basics
- 12.00% Residential construction basics
- 12.00% System components and configurations; system sizing and site assessment
- 15.00% Selecting and adapting system design: mechanical and electrical
- 12.00% Installing subsystems and components
- 10.00% Performance, maintenance, and troubleshooting
- 5.00% Economic analysis and rebates

Laboratory or Activity Content

n/a

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Written expression
Problem solving exercises

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Essay exams
Objective exams
Oral presentations
Problem-solving exams
Problem-solving homework
Quizzes
Skills demonstrations
Classroom Discussion
Projects
Reports/Papers/Journals

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Audio-visual presentations
Case studies
Class discussions
Collaborative group work

Computer-aided presentations
Field trips
Group discussions
Instructor-guided use of technology
Lecture
Problem-solving examples
Readings
Small group activities
Other (specify)

Specify other method of instruction

1. The instructor demonstrates the topic of ground protection of photovoltaic arrays. From this instruction, students are able to design and construct photovoltaic array grounding that meets national electric code standards.
2. Assign primary source materials for students to read prior to class. Instructor holds a quiz on the chapter covering photovoltaic modules followed by in-class discussion with students regarding the effects of environmental conditions and series/parallel connections on the current-voltage (IV) curve.

Describe specific examples of the methods the instructor will use:

- Strong visuals that drive lectures and discussions.
- Linguistic and auditory approaches paired with rhetorical and logical constructs.
- Techniques that make students write and draw the concepts discussed.
- Hands-on activities and group work using solar PV.

Representative Course Assignments

Writing Assignments

- Accurately predict the solar position given a position on Earth, a date, and a time.
- Explain how trends in large scale electrical production from PV and solar-thermal plants will affect the smaller scale rooftop solar industry.
- Given a mock set of site conditions, describe what modifications would be needed to create a system that meets local and national codes.
- Given a set of power consumption data, site data, and current electricity pricing, analyze the pay-off time of a photovoltaic (PV) analog.

Critical Thinking Assignments

- Perform site analysis and system design to meet the power needs of an assigned project.
- Troubleshoot, identify, and document a photovoltaic system performance issue staged by the instructor on a demonstration system.

Reading Assignments

- Read technical manuals on equipment and methods used for photovoltaic systems installation.
- Read articles from online and print sources about current events relating to photovoltaic public policy.

Skills Demonstrations

- Demonstrate technical proficiency understanding individual pieces of equipment used in photovoltaic systems.
- Demonstrate technical proficiency installing and monitoring photovoltaic systems.

Outside Assignments

Representative Outside Assignments

- Read articles from the newspaper, journal articles, and/or Internet sources about solar PV.
- Solve additional problem sets provided by the instructor about PV systems.
- Complete homework problems about PV physics and engineering selected from the textbook or other relevant resource.
- Read material from textbook on solar PV.

Articulation

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
			3

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
De Anza College	ESCI 61	Introduction to Photovoltaic (PV) Technology	3
Diablo Valley College	ENSYS 130	Photovoltaic Systems Design and Installation	2
College of Redwoods	CT 33	Introduction to Solar Photovoltaic Systems	3

District General Education

A. Natural Sciences

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

Course is CSU transferable
Yes

CSU Baccalaureate List effective term:
F2017

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

Area F: Ethnic Studies

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Description
Parrish, Peter. *Photovoltaic Laboratory: Safety, Code-Compliance, and Commercial Off-the-Shelf Equipment*. CRC Press, 2018.

Resource Type
Textbook

Classic Textbook
No

Description
Dunlop, James P. *Photovoltaic systems*. American Technical Publishers, Incorporated, 2012.

Library Resources

Assignments requiring library resources
Research on appropriate applied solar technology topics using journal articles and other sources from the Library's print and online resources.

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources
Research the spectrum of photovoltaic systems on the market and demonstrate understanding of what unites and distinguishes these systems.

Primary Minimum Qualification
EARTH SCIENCE

Review and Approval Dates

Department Chair
02/08/2022

Dean
02/08/2022

Technical Review
02/17/2022

Curriculum Committee
03/01/2022

DTRW-I
03/10/2022

Curriculum Committee
MM/DD/YYYY

Board
04/12/2022

CCCCO
MM/DD/YYYY

DOE/accreditation approval date
MM/DD/YYYY