RC325

Solar Photovoltaic Systems

3 Credits

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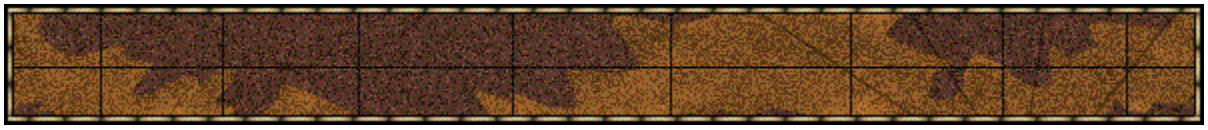

Solar Photovoltaic Systems

Calendar Description

This course reviews solar photovoltaic (solar PV) applications and equipment, focusing on design, installation and maintenance. Using a project-based approach, this course provides advanced details regarding sizing and selecting components, and planning a solar PV project from start to finish.

Rationale

This is a required course for the Renewable Energy and Conservation diploma program. Building on the basics covered in RC205 Introduction to Solar Energy, this course covers topics in solar photovoltaic planning, design and installation in detail. This course prepares students who plan to pursue installer certification and take the required industry exams. Sample exam questions used in the course will give students practice answering the style of question common on many industry exams.

The course guides students through a solar PV project from beginning to end by identifying customer needs, performing a site assessment, selecting equipment and preparing a permit application. By meeting the objectives of this course a student should feel confident proceeding with a solar PV project of their own.

Prerequisites

RC205

The prerequisites may be waived by the department chair if the applicant has prior documented knowledge of the basic skills related to the subject area. However the prerequisites are in place to ensure student success in RC325. A good basic knowledge of the related principles of electricity, heat, energy movement, energy storage, fluid flow, and the types of calculations commonly used in the related industry are required.

Co-Requisites

None

Course Learning Outcomes

Upon successful completion of this course, students will be able to

1. describe the components and functions of common solar photovoltaic systems and their configurations.
2. demonstrate the viability of a solar photovoltaic project given criteria such as cost, practicality and available incentive programs.
3. interpret a customer's needs and desires and explain options for a proposed PV installation in preparation for delivering a quote for services as a PV contractor or installer.
4. determine the design constraints associated with roof mounted solar PV.
5. estimate the solar resource available at a given site accounting for all factors that may limit generation of electricity from a solar PV system
6. perform a comprehensive site assessment that can be used to plan a solar PV installation.
7. correctly design a string of solar PV modules to match an inverter or charge controller.
8. correctly design and match a battery storage system to operate with a string of solar PV modules and charge controller.
9. correctly select properly specified wire, current protection and conduit in accordance to electrical code rules and guidelines.
10. draw a single line diagram for common solar PV system designs complete with component descriptions and ratings suitable to include in a permit application.
11. select and specify an appropriate solar PV mounting system and mounting components for a given installation situation.
12. identify the information necessary to complete a permit application for a solar PV installation project.
13. prepare a budget for a solar PV project and estimate the amortized cost to produce electrical energy from a solar PV system.
14. develop a detailed project design report suitable to deliver to a client, funding agency or to support a project permit application.

Resource Materials

***Required Texts*:**
The NABCEP photovoltaic (PV) Installer Resource Guide is required and can be downloaded from NABCEP web site free of charge.

Brooks, W., and J. Dunlop. 2016. NABCEP photovoltaic (PV) installer resource guide. Clifton Park, New York: Retrieved November 27, 2020 from http://www.nabcep.org/wp-content/uploads/2016/10/NABCEP-PV-Resource-Guide-10-4-16-W.pdf

Dunlop, J.P. 2010. Photovoltaic systems. 2nd ed. National Joint Apprenticeship and Training Committee and American Technical Publishers, Orland Park, Illinois.

***Reference Text*:**
The course builds on content in RC205 and requires RC205 as a prerequisite. As such, you should already own a copy of *Photovoltaic Systems* by Dunlop or *Understanding Photovoltaics* by Warmke. If you have lost your copy, please contact your program administrator for a replacement copy.

Dunlop, J.P. 2012. Photovoltaic systems. 3nd ed. National Joint Apprenticeship and Training Committee and American Technical Publishers, Orland Park, Illinois.

Warmke, J. (2021). Understanding Photovoltaics, An easy to follow study guide for solar electric certification programs. 8th ed., Philo, Ohio: BRS Press

Additional resources are given throughout the learning activities as required.

Conduct of Course

This course consists of the equivalent of 45 hours of lecture delivered on-line using an online learning manager program. Course content modules and links to assigned readings will be available on-line. A course facilitator will be available to guide the learner through the course, answer any questions, and grade assignments. Learners are expected to participate in on-line discussion forums and synchronous conference discussions with other classmates and the course facilitator. Assignments will be submitted electronically by e-mail or through the learning manager program. In addition to regular content and learning activities, this course includes a major term project. Many of the learning activities and assignments prepare students to complete the term project. A written and oral report of the project is required. The oral report is given to the instructor and other students via an on-line conference.

Unit exams are open book and taken on-line. In order to complete the course on time, deadlines for assignments, exam, and projects will be enforced.

Evaluation Procedures

The student's final grade is an aggregate of the following components:

Solar PV Review Exam #1	10%
Assignment 1.1 - Evaluating a PV Incentive Program	5%
Assessment 2.1 - Determining Electrical Loads	5%
Assignment 2.1 - Array Layout	8%
Assignment 2.2 - Shade Analysis	5%
Assignment 2.3 - Site Assessment Case Study #2	8%

Assessment 3.1 PV String and Inverter Design	8%
Assessment 3.2 Batteries and Charge Controllers	8%
Assessment 3.3 Sizing Wire current protection and conduits	8%
Assessment 4.1 Mechanical Integration	4%
Term Project - Written Report	25%
Term Project - Oral Report	6%
TOTAL	100%

Grade Equivalents and Course Pass Requirements

A minimum grade of D (50%) (1.00) is required to pass this course.

Letter	F	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
Percent Range	0-49	50-52	53-56	57-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
Points	0.00	1.00	1.30	1.70	2.00	2.30	2.70	3.00	3.30	3.70	4.00	4.00

Students must maintain a cumulative grade of C (GPA - Grade Point Average of 2.00) in order to qualify to graduate.

Attendance

Active participation is required in all courses within the Renewable Energy and Conservation certificate and diploma programs. Each facilitator designates these requirements through the use of tools within the management system and personal contact with learners.

These expectations can be given marks as part of the assessment process. Each course outlines these expectations within the course structure.

For example, learners can be asked to demonstrate their participation/attendance through discussion forums, sharing research results, contributing relevant information, submitting assignments, communicating with colleagues and the facilitator, and participating in synchronous meetings or asynchronous activities.

Attendance is considered vital to the learning process. Absenteeism is recorded. For example, if a discussion forum is organized; the learner is expected to attend as per the guidelines set by the facilitator.

Students can request for an excused absence. An excused absence is one that is verified with your facilitator.

NOTE: Any exceptions to the above attendance policy (e.g. family or work-related issues) **must** be approved in writing by the Department Chair **prior** to the beginning of the course.

It is the student's responsibility to know their own absentee record.

Course Units/Topics

Module 1: Review of Solar Photovoltaic Systems

- Learning Activity 1.1 Review of Solar PV Systems
- Learning Activity 1.2 - Rational for PV and Incentive Programs

Module 2: Performing a Site Assessment

- Learning Activity 2.1 Determining the Client's Needs
- Learning Activity 2.2 Roof Area, Orientation and Condition
- Learning Activity 2.3 Solar Resource and Shading
- Learning Activity 2.4 Equipment Location and Site Risk Assessments

Module 3: PV System and Component Selection

- Learning Activity 3.1 PV String and Inverter Design Concepts
- Learning Activity 3.2 Battery Sizing
- Learning Activity 3.3 Sizing Wire, Current Protection and Conduit for PV Installations

Module 4: PV System Project Planning

- Learning Activity 4.1: Term Project Assignment
- Learning Activity 4.2: Single line diagrams
- Learning Activity 4.3: Mechanical integration
- Learning Activity 4.4: Preparing a permit application
- Learning Activity 4.5: Preparing a budget and cost analysis

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