COLBY COMMUNITY COLLEGE

Syllabus

Course Number/Title: AE 277 Small Photovoltaic System Basics **Year:** Fall 2012

Department: Business & Technology **Credit Hours: 3**

Required Text: James P. Dunlop, In Partnership with NJATC
Photovoltaic Systems, 2nd Edition
American Technical Publishers, Inc.
Orland Park, Illinois 60467-5756

Days/Time: Lecture Online
Boot camp
Required - TBA

Instructor: Derek Reilley **Room #:** Basement of T. Hall

Office Hours: 8:00 am to 5:00 pm Monday-Friday **Phone:** 785-460-5431 Office
785-443-3856 Cell

Course Placement: Freshman/Sophomore **Pre-requisite:** AE275
Recommended
but not required

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Rationale: With growing concerns about the future and security of the world's energy supply, renewable resources such as solar power are becoming increasingly important. Photovoltaic (solar) is a rapidly growing sector of the energy market. This course is intended for students with little or no solar (photovoltaic) background.

Course Description: This course was designed based on the ten objectives contained in the North American Board of Certified Energy Practitioners (NABCEP) Entry Level Program, this stand alone course will cover: Introduction to Photovoltaic Systems, Solar Radiation, Site Surveys and Preplanning, System Components and Configurations, and Cells, Modules, and Arrays. The course will include a one day boot camp jam packed with hands on training.

Course Outline:

1. Chapter 1: Introduction to Photovoltaic Systems
2. Chapter 2: Solar Radiation
3. Chapter 3: Site Surveys and Preplanning.
4. Chapter 4: System Components and Configurations
5. Chapter 5: Cells, Modules, and Arrays

Course Learning Objectives Assessed:

Colby Community College (CCC) uses the North American Board of Certified Energy Practitioners (NABCEP) to help guide the college in learning outcomes. These outcomes are created for those individuals wanting to attain knowledge and application of solar photovoltaic system operations, CCC's technical track of courses is the perfect curriculum for students wanting to take the NABCEP PV Entry

Level Exam. Below are the ten objectives contained in the North American Board of Certified Energy Practitioners' (NABCEP's) Entry Level Program:

1. PV Markets and Applications
2. Safety Basics
3. Electricity Basics
4. Solar Energy Fundamentals
5. PV Module Fundamentals
6. System Components
7. PV System Sizing Principles
8. PV System Electrical Design
9. PV System Mechanical Design
10. Performance Analysis, Maintenance and Troubleshooting

CCC Student Learning Outcomes (NABCEP) to be measured in This Course

1. PV Module Fundamentals (5.3) Identify the five key electrical output parameters for PV modules using manufacturers' literature (Voc, Isc, Vmp, Imp and Pmp), and label these points on a current-voltage (I-V) curve.
2. PV Module Fundamentals (5.2) Distinguish between PV cells, modules, panels and arrays.
3. PV Module Fundamentals (5.1) Explain how a solar cell converts sunlight into electrical power.

Course Competencies

The overall objective of this course is to provide an introductory course of photovoltaic systems in an interesting, accessible and understandable format for the beginning student.

Chapter 1

- Compare the advantages and disadvantages of installing a PV system.
- List some of the factors that have motivated the growth of PV technology worldwide.
- Evaluate the design priorities for PV systems in different types of applications.
- Identify why it is important for installers to be well trained.
- Differentiate between flat-plate collectors and concentrating collectors.
- Explain how the different types of solar energy technologies utilize solar radiation.

Chapter 2

- Differentiate between solar irradiance (solar power) and solar irradiation (solar energy).
- Identify the factors affecting the quantity and composition of solar energy received on Earth's surface.
- Identify the factors affecting the sun's apparent position and path through the sky.
- Calculate the differences between solar time and standard time.
- Evaluate how array orientation affects solar energy received by modules.
- Demonstrate how solar radiation data is used in sizing and estimating performance for PV systems.

Chapter 3

- Identify issues to be discussed to determine customer needs, concerns, and expectations.
- Identify factors to consider in a preliminary assessment, including the local solar resource, environmental conditions, and building code and utility interconnection requirements.
- Explain the process of determining potential array locations.
- Describe methods for determining and diagramming shading patterns.
- Discuss considerations in determining the suitability and condition of existing roofing, structural systems, and electrical systems and equipment.
- Explain the function of an energy audit and identify opportunities for conservation and energy efficiency.
- Identify factors to be considered when preparing a proposal, including estimates for cost, size, performance, and value of a PV system.

Chapter 4

- Describe the purposes and functions of the major components in PV systems.

- Identify the common types of energy storage systems.
- Compare the functions of various power conditioning devices.
- Describe various energy sources that can be interfaced with PV systems.
- Compare the features, requirements, and applications of various system configurations.
- List various electrical and mechanical balance-of-system components.

Chapter 5

- Identify the relationships between PV cells, modules, and arrays.
- Describe the photovoltaic effect and the fundamental operation of PV devices.
- List the current-voltage (I-V) characteristics for PV devices and define the key I-V parameters.
- Discuss how the electrical load, solar radiation, and operating temperatures affect the electrical output of a PV device.
- Translate the voltage, current, and power output of a PV device from a reference condition to another operating condition.
- Determine the electrical output of similar and dissimilar PV devices connected in series and in parallel.
- Discuss the construction and features of PV modules.
- Describe the various performance rating conditions for PV modules.

Method of Instruction:

Lectures, including Power Point presentations and/or video, assigned reading, class discussions either in the physical classroom or online format, individual assignments. Student questions are an important part of the learning process. Students will be expected to participate in open class discussions and assignments. Be prepared for questions on given topics.

Method of Evaluation:

The student's evaluation whether in the classroom or online, will be based upon discussion and review questions, quizzes and a final exam, and a Boot camp. The following will be how the course will be weighted:

1. Discussion Questions 20%
2. Review Questions 20%
3. Quiz 25%
4. Final Exam 20%
5. Boot camp 15%

Grading Scale

Letter grades are assigned as follows:

90-100	A
80-89	B
70-79	C
60-69	D
Under 60	F

Course Requirements:

Understanding comes from interacting and you cannot interact if you do not participate in class. Be sure to take notes on what you see in Power Point presentations, assigned reading, or during lectures. Important objectives are presented in each class meeting or in each online unit. Communicating your thoughts in the physical classroom or within the online threaded discussion is an important component of learning and participation is an important part of the course.

Assignment Policy:

All assignments must be completed and handed in at the designated times assigned by the instructor. No late work will be accepted. (Usually, assignments will be requested at the beginning of class; any attempt to turn in later will be considered late and not accepted.)

Test Policy:

Instructor reserves the right to schedule proctored exams.

Attendance Policy:

For the physical classroom, attendance is required and roll will be taken daily. Class interaction is important, and material covered in lecture may appear on the test. For online instruction of this course, your attendance is noted by your interaction on the discussion thread and through online assessments.

Assessment
Colby Community College assesses student learning at several levels: general education, program, and course. The goal of these assessment activities is to improve student learning. As a student in this course, you will participate in various assessment activities. An example of your work, a paper, some test questions, a presentation, or other work may be selected for assessment. This process will not affect your grade, will not require you do additional work and your evaluation will be confidentially handled. Results of these activities will be used to improve teaching and learning at Colby Community College.

Syllabus Information Disclaimer I reserve the right to change any information contained in this document, when necessary, with adequate notice given to the student. Notice shall be given in the classroom during class (or online). No other notice is required. It is the students' responsibility to stay current with any changes, modifications, adjustments or amendments that are made to this document."

Accommodations for Students With Disabilities According to the Americans with Disabilities Act, it is the responsibility of each student with a disability to notify the college of his/her disability and to request accommodation. If a member of the class has a documented learning disability or a physical disability and needs special accommodations, he/she should contact Student Support Services, which is located in the Student Union."

Equipment:
PV modules, batteries, charge controllers, inverters, racking systems, and electrical components. Solar Stik (Hybrid off-grid solar photovoltaic and wind turbine power plant that can support both AC and DC loads)

Bibliography:
Dunlop, J. P., & In partnership with NJATC (2010). Photovoltaic Systems (2nd ed.). Orland Park, IL American Technical Publishers, Inc.

Recommended Resources:
1. Photovoltaic Systems, 2nd Edition, by James P. Dunlop, ISBN 978-0-8269-1287-9 ©July 2009 National Joint Apprenticeship and Training Committee and American Technical Publishers: www.jimdunlopsolar.com
2. Code of Federal Regulations, Chapter 29 Part 1926 – Safety and Health Regulations for Construction, Occupational Safety and Health Administration: www.osha.gov
3. 2008 National Electrical Code ®, NFPA 70 or 2008 National Electrical Code® Handbook, National Fire Protection Association®: www.nfpa.org
4. Study Guide for Photovoltaic System Installers, North American Board of Certified Energy Practitioners, Version 4.2, April 2009: www.nabcep.org
5. Photovoltaics Design and Installation Manual, ISBN 978-0-86571-520-2. ©2007 Solar Energy International, New Society Publishers (available in both English and Spanish): www.solarenergy.org

Revised & Approved May 2003
Revised 08/04
Revised 08/11