Western Technical College

10480111 Photovoltaic Design and Installation 1

Course Outcome Summary

Course Information

Description	Students learn the details involved in the mechanical and electrical integration of a PV system. Topics include system components, product specifications, product integration, racking system design capabilities and limits, system diagramming, configurations, safety, common design mistakes and solutions, installation techniques. This course will involve students in the installation of a photovoltaic system.
Career Cluster	Architecture and Construction
Instructional Level	Associate Degree Courses
Total Credits	3
Total Hours	90

Textbooks

Photovoltaic Systems – with CD. 3rd Edition. Copyright 2012. Dunlop, James. P. Publisher: American Technical Publishers, Inc. **ISBN-13**:978-1-935941-05-7. Required.

Experiential Learning

1. Work-Based Learning: this course applies your learning to your desired profession by working in industry placements such as internships, practicums, clinicals, or co-ops.

Course Competencies

1. Investigate the basic theory of a photovoltaic system.

Assessment Strategies

1.1. Written Objective Test

Criteria

You will know you are successful when:

1.1. you compare the advantages and disadvantages associated with installing a photovoltaic system.
1.2. you explain the system priorities for different types of photovoltaic applications.
1.3. you list at least three changes that have created growth in the area of photovoltaic technology.

Learning Objectives

1.a. Compare the advantages and disadvantages of installing a photovoltaic system.
1.b. Evaluate the design priorities for different types of photovoltaic applications.
1.c. List some of the factors that have created growth in the photovoltaic technology globally.

2. Explore the different forms of solar radiation.

Assessment Strategies

2.1. Written Objective Test
2.2. Demonstration

Criteria

You will know you are successful when

2.1. you describe the difference between solar irradiance and irradiation.
2.2. you determine how the azimuth angle of an array affects its energy output.
2.3. you identify environmental and seasonal influences on solar radiation.
2.4. you measure irradiance with an irradiance meter.

Learning Objectives

2.a. Differentiate between solar irradiance and solar irradiation.
2.b. Evaluate how array orientation affects solar energy received by modules.
2.c. Identify factors that affect the amount of solar radiation reaching the earths surface.
2.d. Measure solar irradiance under different weather conditions.

3. Identify the requirements that create a favorable photovoltaic site location.

Assessment Strategies

3.1. Demonstration
3.2. Written Objective Test

Criteria

You will know you are successful when:

3.1. you perform a site assessment to determine if a site is suitable for a photovoltaic system.
3.2. you determine what loads can be shifted to other energy sources to best size a photovoltaic system.
3.3. you determine if a location will suitable for a photovoltaic system based on seasonal shading patterns.
3.4. you explain the process for determining the proper location of a photovoltaic system.

Learning Objectives

3.a. Perform a site assessment to determine if a location is favorable to installing a photovoltaic system.
3.b. Perform an energy audit to determine where energy can be conserved to best size the photovoltaic system to meet the energy demands.
3.c. Describe methods to determine shading patterns that will impact the photovoltaic arrays performance.
3.d. Explain the process of determining potential array locations.

4. Calibrate and set-up a solar pathfinder.

Assessment Strategies

4.1. Demonstration

Criteria

You will know you are successful when:

4.1. you determine which sunpath diagram to use for your location.
4.2. you properly level and align the compass of the pathfinder.
4.3. you collect data from the pathfinder.

Learning Objectives

4.a. Select the correct sunpath diagram for you latitude.
4.b. Align the pathfinder compass correctly to align with magnetic north.
4.c. Perform the leveling procedure for the pathfinder.
4.d. Verifiy the pathfinder is level and magnetically aligned before taking any measurements.
4.e. Collect and analyze data from the pathfinder.

5. Determine the amount of energy potentially produced at a selected photovoltaic site.

Assessment Strategies

5.1. Written Objective Test
5.2. Presentation

Criteria

You will know you are successful when

5.1. you use the pathfinder to determine the solar window for a specific location.
5.2. you use the pathfinders software to determine the amount of solar energy that can be produced from a specific location.
5.3. you use web based applications to determine the amount of energy that can be produced at a specific location.

Learning Objectives

5.a. Use pathfinder software to determine the solar window for a specific location.
5.b. Determine the amount of solar energy that can be captured from a site using the pathfinder assistant.
5.c. Use web based software applications to determine how much power can be produced at a site you've tested with the pathfinder.
5.d. Compare and explain the differences between the web software and the pathfinder.

6. Examine load shifting effect on photovoltaic installation costs.

Assessment Strategies

6.1. Written Objective Test
6.2. Presentation

Criteria

You will know you are successful when

6.1. you explain load shifting.
6.2. you list the load at a residence or business that are candidates for load shifting.
6.3. you calculate how much shifting loads will save on installed photovoltaic costs.

Learning Objectives

6.a. Explain what load shifting is and how it affects photovoltaic installations.
6.b. Evaluate you residence for a list of all your electric loads.
6.c. Determine which loads are good candidates for load shifting.
6.d. Calculate how much each shifted load will reduce your electrical usage.
6.e. Calculate how much load shifting will save you on installed photovoltaic costs.

7. Investigate the basic components associated with a photovoltaic system.

Assessment Strategies

7.1. Written Objective Test

Criteria

You will know you are successful when:

7.1. you list the basic components of a photovoltaic system.
7.2. you describe the functions of various power conditioning devices.
7.3. you list the most common types of energy storage systems used with photovoltaic systems.
7.4. you list the most common balance of systems components in a photovoltaic system.

Learning Objectives

7.a. List the components associated with a photovoltaic system.
7.b. Identify the mechanical balance of system components.
7.c. Discuss the most common types of energy storage systems for photovoltaic systems.
7.d. Describe the functions of various power conditioning devices.
7.e. List the electrical balance of system components.

8. Explore photovoltaic cells and panels.

Assessment Strategies

8.1. Written Objective Test
8.2. Demonstration

Criteria

You will know you are successful when

8.1. you identify the difference between photovoltaic cells, modules and arrays.
8.2. you describe the photovoltaic effect.
8.3. you explain how current and voltage are related in a photovoltaic cell.
8.4. you measure the current and voltage from a photovoltaic panel.

Learning Objectives

8.a. Identify the relationship between photovoltaic cells, modules and arrays.
8.b. Describe the photovoltaic effect.
8.c. Explain the current voltage/voltage characteristics for a photovoltaic cell/panel.

9. Demonstrate how panels are connected together to produce the desired voltage.

Assessment Strategies

9.1. Skill Demonstration
9.2. Written Objective Test

Criteria

You will know you are successful when

9.1. you connect the correct number of panels to together to achieve a desired output voltage.
9.2. you design an array with the desired voltage and current output.

Learning Objectives

9.a. Demonstrate how panels are connected in series to achieve the desired voltage.
9.b. Connect panels in parallel to create the desired current output.
9.c. Design a series parallel array to achieve the desired voltage and current.

10. Interpret specifications found on solar panels.

Assessment Strategies

10.1. Skill Demonstration
10.2. Written Objective Test

Criteria

You will know you are successful when

10.1. you use a manufactures web site to determine the open circuit voltage of a panel.
10.2. you measure the short circuit current of a panel.
10.3. you plot the current voltage curve of a selected panel based on measurements.

Learning Objectives

10.a. Locate the manufacturers specification for a photovoltaic panel.
10.b. Determine the rated short circuit current of a panel.
10.c. Identify the open circuit voltage of a panel.
10.d. Measure the open circuit voltage and short circuit current of a panel.