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Northeast Wisconsin Technical College

10-482-132 059261 Photovoltaics-Design & Site

Course Outcome Summary

Course Information

Description	10-482-132 PHOTOVOLTAICS-DESIGN & SITE ...learn steps to performing a site audit prior to installation of a PV system. Focus on defining the solar window, system site placement, system sizing and design, load analysis and energy efficiency concepts. (Corequisite: 10-482-126, Intro to Solar)
Total Credits	3
Total Hours	72

Course History

Last Revision Date	2/27/2017
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Employability Skills

- Communicate Effectively
- Demonstrate Community and Global Accountability
- Demonstrate Personal Accountability
- Solve Problems Effectively
- Think Critically and Creatively
- Value Individual Differences and Abilities
- Work Cooperatively and Professionally

Program Outcomes

- TSA1 - Evaluate renewable, fossil and other energy resources in context of sustainability, environment, society and economics
- TSA2 - Evaluate building performance and energy use
- TSA3 - Recommend building/site solutions to optimize performance
- TSA4 - Install equipment and materials to optimize performance
- TSA5 - Service equipment and systems

Course Competencies

1. Describe the elements of photovoltaic system design.

Assessment Strategies

by describing the elements of a photovoltaic system design.

Learning Objectives

- 1.a. Identify the basic types of photovoltaic systems.
- 1.b. Explain the best application and limitation of each system type.
- 1.c. Describe the hardware components of a photovoltaic system.
- 1.d. Identify photovoltaic mounting types.
- 1.e. Describe the basics of photovoltaic system design.
- 1.f. Describe the required components of one line diagrams.
- 1.g. Describe installation techniques.
- 1.h. Explain the basics of system costs and economics.

Criteria

Your performance will be successful when:

you can list the major components of a photovoltaic system: photovoltaic modules, inverter, interconnection, and balance of system.

you can describe how a photovoltaic system is designed.

you can describe the basic elements of cost and economic calculation.

you can describe basic installation techniques.

you can draw a one line diagram.

you can apply the optimum mounting type.

2. Examine the basics of roof design.

Assessment Strategies

by describing the basics of roof design.

Learning Objectives

- 2.a. Describe basic residential roof design.
- 2.b. Describe basic commercial roof design.
- 2.c. Describe roof load issues.
- 2.d. Explain basic photovoltaic system roof mounting options.

Criteria

Your performance will be successful when:

you can describe the basics of roof design for flat and pitched roof including structural support options, roof structural material, and weather sealing options.

you can describe the roof loading issues for a photovoltaic system including dead load, live load, snow load, and margin.

you can describe the basic mounting options for a photovoltaic system on a roof including ballasted, and roof penetrating methods.

3. Perform a site inspection for a solar site analysis.

Assessment Strategies

by performing a site inspection for a solar site analysis.

Learning Objectives

- 3.a. Use site assessment tools.
- 3.b. Determine solar resource.
- 3.c. Conduct a building energy load analysis.
- 3.d. Identify photovoltaic array placement options.
- 3.e. Determine suitable locations for installing inverters and other balance-of-system components.

Criteria

Your performance will be successful when:

you can successfully use site analysis tools.

you can evaluate locations for system components.
you can perform a building's energy load calculation.
you can estimate the size of a photovoltaic system.
you can estimate the costs of a photovoltaic system.
you can estimate the performance of a photovoltaic system.

4. Design an appropriate photovoltaic system for a site.

Assessment Strategies

by designing an appropriate photovoltaic system for a site.

Learning Objectives

- 4.a. Recommend a photovoltaic system type based on results of a site inspection.
- 4.b. Estimate the size of a photovoltaic system based on the customer's energy requirements and physical information for the site.
- 4.c. Calculate a general cost estimate of the photovoltaic system based on the photovoltaic system type and size

Criteria

Your performance will be successful when:

your photovoltaic assessment report explains the physical characteristics of the site.
your photovoltaic assessment report explains the possible photovoltaic system configurations.
your photovoltaic assessment report estimates cost and performance.
your photovoltaic site assessment provides installer and equipment vendor information.
you communicate the results to the site owner.

5. Utilize photovoltaic system analysis software.

Assessment Strategies

by utilizing photovoltaic system analysis software.

Learning Objectives

- 5.a. Use internet-based performance calculators
- 5.b. Calculate a general cost estimate

Criteria

Your performance will be successful when:

you can identify the commonly used photovoltaic system internet-based analysis software tools.
you can use RetScreen software to estimate the performance of a photovoltaic system.
you can use PVWatts software to estimate the performance of a photovoltaic system.
you can explain the output from photovoltaic analysis software programs.

6. Explain relevant codes, standards, and certification.

Assessment Strategies

by explaining relevant codes, standards, and certification.

Learning Objectives

- 6.a. Describe basic building code issues relevant to photovoltaic installations
- 6.b. Describe the basic interconnection regulations
- 6.c. Investigate photovoltaic installer training and certification requirements

Criteria

Your performance will be successful when:

you can describe the basic codes relevant to photovoltaic system installations.
you can describe the basic standards relevant to photovoltaic system installations.
you can describe the basic safety requirements relevant to photovoltaic system installations.
you can describe the basic utility interconnection regulations for photovoltaic systems.
you can describe the basic photovoltaic installer training requirements and certifications.

7. Apply various photovoltaic mounting and racking systems.

Assessment Strategies

by describing the various types of photovoltaic mounting and racking types.

Learning Objectives

- 7.a. Describe typical PV racking and installation for shingle roof applications.
- 7.b. Describe typical PV racking and installation for standing seam and corrugated steel roof applications.
- 7.c. Describe pole mount PV systems racking, mast and foundations requirements.
- 7.d. Describe various ground mount PV system racking and foundations requirements.
- 7.e. Describe single and dual axis PV system racking, mast and foundations requirements.
- 7.f. Describe various ground mount PV system racking and foundations requirements.

Criteria

you can describe roof mounting and racking system components
you can describe pole mounting systems including foundation requirements
you can describe typical ground mounting racking and foundations.
You can describe both single axis and dual axis pole mounting trackers.
You can describe available ground mounting tracking systems.

8. Explain the economic and financial considerations for Photovoltaic systems.

Assessment Strategies

by explaining the economic and financial considerations for photovoltaic systems

Learning Objectives

- 8.a. Estimate PV system component and installation costs.
- 8.b. Define and calculate Simple Payback.
- 8.c. Define and calculate Return on Investment for various PV systems.
- 8.d. Define and calculate Internal Rate of Return for various PV systems.
- 8.e. Define and calculate Net Present Value for various PV systems.
- 8.f. Define and calculate Profitability Index for various PV systems.
- 8.g. Define and calculate Cumulative Cash Flow for various PV systems.
- 8.h. Incorporate incentives such as grants and tax credits into your financial calculations.

Criteria

You can estimate photovoltaic system component & installation costs.
You can define and calculate Simple Payback.
You can define and calculate Return on Investment for various photovoltaic systems.

you can define and calculate Internal Rate of Return.
you can define and calculate Net Present Value.
you can define and calculate Profitability Index.
you can define and calculate Cumulative Cash Flow.
you can incorporate incentives such as grants and tax credits into your calculations.

9. Design a photovoltaic system by correctly integrating system components

Assessment Strategies

You can properly design a photovoltaic system by correctly integrating components for your specific site and application.

Learning Objectives

- 9.a. Calculate voltage and current for PV modules for various design & temperature applications.
- 9.b. Determine correct string configurations for PV modules and inverters for design conditions.
- 9.c. Match various PV arrays to various inverters.
- 9.d. Select appropriate inverters for specific utility inter-tie voltage requirements.
- 9.e. Properly apply micro inverters to specific PV modules and utility inter-tie requirements.

Criteria

you can calculate voltage and current changes due to temperature for photovoltaic modules
You can properly string size photovoltaic arrays for different string inverters.

You can match photovoltaic array specifications to inverter specifications.

you can properly apply micro inverters to specific photovoltaic modules.

10. Prepare and understand permitting and utility intertie forms and requirements to photovoltaic systems.

Assessment Strategies

you understand and can prepare required permit and utility intertie agreements forms and applicaitons for a photovoltaic system.

Learning Objectives

- 10.a. Summarize local permitting requirements for PV systems.
- 10.b. Obtain and complete permitting applications and discuss with the local AH J.
- 10.c. Summarize the utility inter-tie requirements for PV systems.
- 10.d. Obtain & complete the correct utility inter-tie applications and agreement for a PV system.
- 10.e. Explain the permitting process to a client.
- 10.f. Explain the utility inter-tie requirements and application process to a client.

Criteria

you understand the local permitting requirements for photovoltaic systems

you are able to obtain, complete, and submit the correct applications to the AHJ.

you understand the local utility intertie requirements for photovoltaic systems.

you are able to obtain, complete and submit the correct utility intertie application and agreement for the applicable utility.

you can explain the permitting process to a client.

you can explain the utility intertie requirements and application process to a client.