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Northeast Wisconsin Technical College

10-482-126 057588 Introduction to Solar

Course Outcome Summary

Course Information

Description	10-482-126 INTRODUCTION TO SOLAR ...an overview of the use of sunlight to produce heat and electricity and the practical and economical use of solar power and solar thermal systems. Learn the importance of energy efficiency and the economics of solar hybrid designs.
Total Credits	4
Total Hours	72

Course History

Last Revision Date	12/18/2017

Pre/Corequisites

None

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 energy and its different forms

Assessment Strategies

by describing energy and its different forms.

Learning Objectives

1.a. Define energy
1.b. Discuss conservation of energy
1.c. Contrast energy and energy carrier
1.d. Discuss sources of fuel
1.e. Describe how 'energy' is produced
1.f. Describe how electricity is produced

Criteria

Your performance will be successful when:

you differentiate between kinetic and potential energy
you identify the different forms of kinetic energy.
you identify the different forms of potential energy.
you describe the concept of conservation of energy

2. Describe how society uses energy

Assessment Strategies

by describing how modern society uses energy

Learning Objectives

2.a. Describe how energy is used in modern society
2.b. Characterize the energy production 'value chain'
2.c. Identify the providers of energy
2.d. Compare energy use in developed and developing countries
2.e. Describe energy infrastructure
2.f. Explore modern society's dependence on energy
2.g. Characterize end-use energy efficiency
2.h. Describe electricity production in terms of Base-load, Load Following, and Peaking
2.i. Summarize the history of energy use

Criteria

Your performance will be successful when:

you describe society's dependence on energy
you describe energy efficiency

3. Evaluate the pros and cons of society's current energy sources

Assessment Strategies

by evaluating the pros and cons of society's current primary energy sources

Learning Objectives

3.a. Characterize energy resources
3.b. Contrast energy reserves with proven reserves
3.c. Explain resource distribution
3.d. Discuss resource depletion
3.e. Explain Peak Oil
3.f. Describe energy issues including Balance of Trade, National Security, Nationalization, and Geo-political concerns
3.g. Characterize emissions from energy production and use
3.h. Explain the harmful effects from emissions

Criteria

Your performance will be successful when:

you describe the limits of the world's fossil fuel resources
you describe the negative implications of the world's dependence on fossil fuels

4. Identify how renewable resources can be used to make energy

Assessment Strategies
by identifying how renewable resources can be used to make energy

Learning Objectives
4.a. Define Renewable Energy
4.b. Identify renewable resources
4.c. Describe renewable energy devices and technology
4.d. Explain Alternative Fuels
4.e. Contrast renewable energy and alternative fuels

Criteria

Your performance will be successful when:

you can describe renewable energy resources
you can describe the types of energy produced by renewable resources

5. Explain the pros and cons of renewable energy

Assessment Strategies
by explaining the pros and cons of renewable energy

Learning Objectives
5.a. Describe at a high level the operation of the primary renewable energy devices
5.b. Define first cost and its importance to renewable energy equipment
5.c. Characterize the availability of renewable resources

Criteria

Your performance will be successful when:

you can define first cost and its implications to renewable energy equipment
you can describe the operation of the primary renewable energy devices
you can describe the availability of renewable energy resources

6. Define Solar Energy as an energy resource

Assessment Strategies
by defining solar energy

Learning Objectives
6.a. Characterize the energy the Earth receives from the sun
6.b. Describe the variation in the level of energy reaching the Earth
6.c. Explain how the Earth's atmosphere reduces the energy reaching the Earth's surface
6.d. Explain what sun angle is and its impact on energy received
6.e. Describe how the amount on energy received on a flat surface varies over the year
6.f. Explain how siting affects the amount of energy received
6.g. Identify information sources for finding solar radiation levels.

Criteria

Your performance will be successful when:

you can describe how the energy from the sun varies throughout the year
you can describe how the orientation of a surface impacts the amount of solar energy received

7. Describe how Solar Energy is used to make electricity.

Assessment Strategies
by describing solar electricity

Learning Objectives

7.a. Describe the photoelectric effect
7.b. Contrast solar electricity and solar heating
7.c. Explain how a solar cell makes electricity
7.d. Explain how a solar cell is made
7.e. Characterize the different types of photovoltaic material
7.f. Describe a photovoltaic panel
7.g. Identify photovoltaic panel manufacturers

Criteria

Your performance will be successful when:

you can define the photoelectric effect
you can describe how a solar cell produces electricity

8. Describe the different components of a photovoltaic system

Assessment Strategies

by describing the major components of a photovoltaic system

Learning Objectives

8.a. Describe the function of a photovoltaic panel
8.b. Describe the function of an inverter
8.c. Explain the concept of interconnection
8.d. Characterize interconnection to the electrical grid
8.e. Identify other interconnection components
8.f. Characterize mounting hardware
8.g. Explain balance of system
8.h. Characterize building-integrated photovoltaic
8.i. Explain remote off grid photovoltaic systems and the function of batteries

Criteria

Your performance will be successful when:

you can identify the major components of a solar electric system and their function
you will draw one-line system diagram to illustrate a complete photovoltaic system

9. Explain the steps involved in a photovoltaic system installation.

Assessment Strategies

by describing the major components of a photovoltaic system installation process

Learning Objectives

9.a. Describe a solar electric (photovoltaic) site assessment
9.b. Contrast a good versus a poor site for a photovoltaic system installation
9.c. Explain the function of a photovoltaic system designer
9.d. Explain the function of a photovoltaic system installer
9.e. Identify individual photovoltaic system cost components
9.f. Describe a photovoltaic system cost analysis
9.g. Explain the concept of net-metering
9.h. Explain financial incentives
9.i. Characterize a utility interconnection agreement
9.j. Describe interconnection standards
9.k. Explain commissioning

Criteria

Your performance will be successful when:

you can differentiate between a good and poor solar site
you can describe the tasks performed by a photovoltaic system designer and an installer
you identify insurance requirements for an interconnection agreement
you describe the net-metering provisions for an interconnection agreement
you describe the cost of an interconnection agreement for a building owner
you describe how you commission a photovoltaic system

you describe how a typical home owner would evaluate the cost effectiveness of a photovoltaic system.

10. Describe how Solar Energy is used to heat water and air for use in buildings.

Assessment Strategies

by describing how Solar Energy is used to heat water and air for use in buildings.

Learning Objectives

10.a. Identify where heat is needed and used in buildings
10.b. Determine the amount of energy that is available from solar energy
10.c. Differentiate between water and air heat exchangers
10.d. Describe types of heat transfer
10.e. Distinguish between low grade and high grade heat sources and use requirements

Criteria

Your performance will be successful when:

you describe heat transfer processes: radiation, natural convection, forced convection & conduction
you determine the amount of energy available from the collectors
you determine the building space heating and hot water heating loads
you compare types of solar hot water collectors
you compare types of solar air heating collectors
you explain the difference between low grade and high grade heat requirements and their suitability to solar thermal systems

11. Compare types of solar hot water heating systems and determine their suitability for the application

Assessment Strategies

by describing types of solar hot water heating systems and their applications

Learning Objectives

11.a. Describe & discuss an open loop solar thermal system and it's applications
11.b. Describe a discuss closed loop / pressurized solar thermal system and it's applications
11.c. Describe and discuss an ICS solar thermal system and it's applications
11.d. Describe and discuss a drain back system and it's applications
11.e. Describe a typical outdoor swimming pool solar thermal system
11.f. Describe a typical indoor swimming pool solar thermal system
11.g. Sketch out the different types of solar hot water systems including all major components and all necessary balance of system components

Criteria

Your performance will be successful when:

you describe an open loop solar thermal system
you describe a closed loop / pressurized solar thermal system
you describe an ICS solar thermal system
you describe a drain back system
you Describe a typical outdoor swimming pool solar thermal system
you describe a typical indoor swimming pool solar thermal system

12. Analyze the purpose & operation of the different components of a solar hot water system.

Assessment Strategies

by identifying the different components of a solar hot water system

Learning Objectives

12.a. Discuss the overall purpose of the solar hot water system
12.b. Discuss the purpose of the solar hot water collector
12.c. Identify the different components of a solar hot water system.
12.d. Describe a flat plate solar thermal collector
12.e. Explain how an evacuated heat pipe collector functions
12.f. Compare flat plate and evacuated heat pipe collectors
12.g. Describe the function of a solar storage tank
12.h. Explain the purpose of the heat exchanger(s)

12.i. Explain the purpose and operation of a differential controller
12.j. Compare different heat transfer fluids
12.k. Compare AC & DC pumped solar thermal systems
12.l. Describe balance of system components

Criteria

Your performance will be successful when:

you describe different solar water heating processes
you compare different solar water heating collectors and their applications
you describe control systems and their applicability for different types of solar water heating processes
you describe solar water heating racking and mounting components
you describe solar air heating piping and wiring techniques

13. Compare types of solar air heating systems.

Assessment Strategies
by comparing types of solar air heating systems

Learning Objectives
13.a. Describe a hot air solar heating system
13.b. Describe a transpired solar collector
13.c. Explain the benefits of solar air collectors
13.d. Describe different applications for solar air heating systems

Criteria

Your performance will be successful when:

you describe a transpired solar collector
you describe a transpired solar collector
you explain the benefits of solar air collectors
you describe different applications for solar air heating systems

14. Analyze the purpose & operation of the different components of a solar air heating system.

Assessment Strategies
by identifying the different components of a solar air heating system

Learning Objectives
14.a. Discuss the overall purpose of the solar air heating system
14.b. Identify the different components of a solar air heating system.
14.c. Explain how a flat plat solar air collector works
14.d. Discuss the function of a transpired solar collector
14.e. Describe the control mechanisms for solar air heating systems
14.f. Draw a typical solar air heating system and inlcude major components and all necessary balance of systems components
14.g. Explain the means of transferring heat from a solar air collector
14.h. Sketch a simple solar air heating system wiring diagram
14.i. Describe solar air heating piping requirements

Criteria

Your performance will be successful when:

you describe different solar air heating processes
you compare different solar air heating collectors and their applications
you describe control systems and their applicability for different types of solar air heating processes
you describe solar air heating racking and mounting components
you describe solar air heating piping and wiring techniques

15. Explain the steps involved in solar thermal system installation.

Assessment Strategies
by explaining the steps involved in a solar thermal system installation

Learning Objectives
15.a. Describe a solar thermal site assessment

15.b. Contrast a good versus a poor site for a solar thermal system installation
15.c. Explain the function of a solar thermal system designer
15.d. Explain the function of a solar thermal system installer
15.e. Identify individual solar thermal system components
15.f. Explain proper sizing of solar thermal system components
15.g. Explain a solar thermal cost analysis
15.h. Explain financial incentives
15.i. Describe the sequence of system commissioning

Criteria

Your performance will be successful when:

you explain the steps involved in doing a site assessment
you explain the system design process
you explain the process of obtaining permitting and possible incentives
you explain the installation and construction techniques involved with system installation
you explain the system commissioning process
you explain proper system component labelling
you explain system maintenance procedures and schedules

16. Explain the process of producing electricity from solar thermal concentrating collectors

Assessment Strategies

by explaining the proces of producing electricity from a solar thermal concentrating collector system

Learning Objectives

16.a. Describe a concentrating solar thermal collector
16.b. Explain the major components of a concentrating solar thermal power plant
16.c. Compare the efficiency of photovoltaic energy production and a concentrating solar thermal power plant

Criteria

Your performance will be successful when:

you describe concentrating solar thermal collectors
you describe the major components of a concentrating solar thermal power plant
you sketch the major components of a concentrating solar thermal power plant
you compare the efficiency of photovoltaic energy production and a concentrating solar thermal power plant

17. Explain the process of air conditioning using solar thermal collectors

Assessment Strategies

by explaining the proces of air conditioning using a solar thermal system.

Learning Objectives

17.a. Describe an absorption refrigeration/cooling process
17.b. Describe all major components of solar thermal absorption air conditioning/refrigeration system
17.c. Compare the efficiency of standard air conditioning systems with solar thermal air conditioning systems

Criteria

Your performance will be successful when:

you describe an absorption refrigeration process
you sketch all major components of solar thermal absorption air conditioning/refrigeration system
you label all major components of solar thermal absorption air conditioning/refrigeration system
you compare the efficiency of standard air conditioning systems with solar thermal air conditioning