CNST A158: PHOTOVOLTAIC SYSTEM INSTALLATION 2

Item	Value
Curriculum Committee Approval Date	12/02/2020
Top Code	094610 - Energy Systems Technology
Units	4 Total Units
Hours	96 Total Hours (Lecture Hours 45; Lab Hours 51)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)

Course Description

Presents principles of Photovoltaic Systems and incorporates hands on activities for all topics. Solar Energy fundamentals and applications, electricity and safety basics, PV modules, system components, system sizing, electrical design, mechanical design and performance analysis and troubleshooting. PREREQUISITE: CNST A157. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Calculate site variables and electrical load to determine materials and equipment for effective energy efficiency in a residential roof mounted photovoltaic system.
2. Determine safe procedures for the layout, assembly, mounting and electrical connections for all parts of the system as specified on plan design.

Course Objectives

- 1. Identify photovoltaic cell and module characteristics as they apply to the design and performance of integrated systems.
- 2. Calculate system characteristics such as wire sizes to minimize power losses and maximize energy production.
- 3. Use applicable wiring methods and technologies.
- 4. Determine mechanical/structural mounting of racking, modules and electrical equipment.
- 5. Work off plans and schematics for on site design implementation.
- 6. Evaluate electrical load estimates
- 7. Specify appropriate inverter types and sizes for each system
- 8. Layout and assemble solar modules/array and BOS (Balance of System) components.

Lecture Content

Orientation of lab classroom, equipment and safety procedures Review of the course syllabus, class expectations, resources, textbook, websites How Photovoltaic systems work Safety Basics Lab activity and pretest System Components and Configurations Sources of electricity Off-grid or standalone systems and grid-tied systems Configurations of PV systems Lab Activity Photovoltaic Electricity Basics Electrical terminology Electric Load analysis Circuit values Lab Activity Cells, Modules, and Arrays PV cell materials, use and fabrication Function and construction of modules and arrays Maximum power point, operating point, and system resistance Lab Activity Inverters, Batteries, Charge Controllers AC power and PV Inverters Function and types of batteries Charge controllers types, setpoints, applications Lab Activity Solar Energy Fundamentals Peak sun and PV performance Measuring tools and calculations for irradiation Array orientation Lab Activity Site Surveys and Preplanning Array locations Roof construction and materials Shading analysis Electrical assessment Lab Activity System Design and Sizing Sizing methodologies and calculations Load demand System output derating factors Lab Activity Mechanical Integration or Adapting the Mechanical Design Mounting configurations Integration of arrays and other system equipment Lab Activity Electrica l Integration National Electrical Code Conductors and wiring methods Lab Activity Electrical Integration Overcurrent Protection Disconnects Grounding Lab Activity Installation Procedures Materials selection Equipment checklist Sequence Lab Activity Utility Interconnection Interactive distributed generation Utility interconnection policies Lab Activity Permitting and Inspection Building codes and regulations Lab Activity Performance Analyses and Troubleshooting a System Design errors, performance problems Maintenance for a PV system Monitoring and measuring output Lab Activity NABCEP Exam (optional)

Lab Content

Orientation of lab classroom, equipment and safety procedures Review of the course syllabus, class expectations, resources, textbook, websites How Photovoltaic systems work Safety Basics Lab activity and pretest System Components and Configurations Sources of electricity Off-grid or standalone systems and grid-tied systems Configurations of PV systems Lab Activity Photovoltaic Electricity Basics Electrical terminology Electric Load analysis Circuit values Lab Activity Cells, Modules, and Arrays PV cell materials, use and fabrication Function and construction of modules and arrays Maximum power point, operating point, and system resistance Lab Activity Inverters, Batteries, Charge Controllers AC power and PV Inverters Function and types of batteries Charge controllers types, setpoints, applications Lab Activity Solar Energy Fundamentals Peak sun and PV performance Measuring tools and calculations for irradiation Array orientation Lab Activity Site Surveys and Preplanning Array locations Roof construction and materials Shading analysis Electrical assessment Lab Activity System Design and Sizing Sizing methodologies and calculations Load demand System output derating factors Lab Activity Mechanical Integration or Adapting the Mechanical Design Mounting configurations Integration of arrays and other system equipment Lab Activity Electrica l Integration National Electrical Code Conductors and wiring methods Lab Activity Electrical Integration Overcurrent Protection Disconnects Grounding Lab Activity Installation Procedures Materials selection Equipment checklist Sequence Lab Activity Utility Interconnection Interactive distributed generation Utility interconnection policies Lab Activity Permitting and Inspection Building codes and regulations Lab Activity Performance Analyses and Troubleshooting a System Design errors, performance problems Maintenance for a PV system Monitoring and measuring output Lab Activity NABCEP Exam (optional)

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- Lab (04)
- DE Live Online Lab (04S)

Instructional Techniques

Lecture, Presentations, Demonstrations, Hands-on Activities, Guest Speakers, Cooperative Learning

Reading Assignments

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Writing Assignments

Completion of lab and homework assignments in a neat, workmanlike manner that meet safety and industry standards.

Out-of-class Assignments

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Demonstration of Critical Thinking

Written tests that may be identification, multiple choice, fill-in the blank, and mathematical calculation. Participation in class discussions and presentations. Lab assignments completed in timely manner.

Required Writing, Problem Solving, Skills Demonstration

Completion of lab and homework assignments in a neat, workmanlike manner that meet safety and industry standards.

Textbooks Resources

1. Required Dunlop, Jim. Photovoltaic Systems. , ed. Illinois: : American Technical Publishers, Inc. in partnership with the National Joint Apprenticeship and Tra, 2007 2. Required North American Board of Energy Practitioners. . Study Guide for Photovoltaic System Installers, ed. . NABCEP. http://www.nabcep.org/, 2008 3. Required National Fire Protection Association. National Electrical Code 2008, ed. New York: Thomson Delmar Learning, 2007