Energy | American River College

This certificate provides training in all aspects of solar photovoltaic (PV) system design, cost estimation, sales, and installation. It also includes training in oral presentations and management skills. The courses included in the certificate also qualify students to take the North American Board of Certified Energy Practitioners (NABCEP) PV Entry Level Certificate of Knowledge Exam.

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Certificates of Achievement

Solar Energy Systems Design, Estimation, and Sales Certificate

This certificate provides training in all aspects of solar photovoltaic (PV) system design, cost estimation, sales, and installation. It also includes training in oral presentations and management skills. The courses included in the certificate also qualify students to take the North American Board of Certified Energy Practitioners (NABCEP) PV Associate Certificate of Knowledge Exam.

Certificate Requirements

COURSE CODE	COURSE TITLE	UNITS
ET 302	Principles of Electricity and Electronics	4
ENERGY 140	Electrical Applications for Solar Installers	3
ENERGY 141	Electrical & Mechanical Applications for Solar Installers	3
ENERGY 142	NABCEP Associate Certification Preparation	2
ENERGY 143	Solar Photovoltaic Systems Design, Installation, and Troubleshooting	4
SPEECH 301	Public Speaking	3
BUS 300	Introduction to Business (3)	3
or BUS 350	Small Business Management/Entrepreneurship (3)	
Total Units:		22

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- describe the components in a complete grid-tie PV system.
- construct solar PV battery charging systems.
- analyze test equipment data to determine the location of the "sweet spot" on a solar PV panel's Current--Voltage (IV) curves.
- identify tools and test equipment necessary for solar PV panel installations.

- identify different sizes of wire according to American Wire Gauge (AWG) tables.
- describe the advantages of obtaining the NABCEP Associate Certificate of Knowledge Certificate.
- construct a simulated roof system using industry standard building materials.
- calculate the amount of yearly solar radiance in relationship to shading using the Solmetric's SunEye predictor and software.
- inspect and repair malfunctioning components in a functioning grid tie solar PV system.
- estimate the yearly power output for a solar photovoltaic system using both the SunEye and the Pathfinder sun angle and shade predictor.
- identify typical locations of electrical/mechanical failures in PV systems.
- maximize communication effectiveness by specifying, planning for, and adapting to the specific audience.
- identify and analyze factors that contribute to effective design, development, and delivery of presentations.
- relate the communication process to public speaking situations.
- assess the ways to start a business and which form of business organization should be used.
- explain the importance of a business plan, a financial plan, and a marketing plan.
- describe the financing process and how to access capital.
- apply principles of management and marketing relevant to the small business.
- evaluate financial reports.
- analyze the impact of legal requirements and government regulations as related to the operation of the small business.

Career Information

This certificate prepares students for entry level employment in a wide variety of positions in the PV industry. It is also valuable for people working in the PV industry to upgrade their skills to include the newest advancements in solar technology. Career opportunities include PV system designers, PV systems outside sales, PV equipment and associated component sales representatives, and a variety of other emerging careers in this field.

Solar Energy Technology Certificate

This certificate provides training in all aspects of solar photovoltaic (PV) system design, installation, troubleshooting, and repair. The courses included in the certificate also qualify students to take the North American Board of Certified Energy Practitioners (NABCEP) PV Associate Certificate of Knowledge Exam.

Certificate Requirements

COURSE CODE	COURSE TITLE	UNITS
ET 302	Principles of Electricity and Electronics	4
ENERGY 140	Electrical Applications for Solar Installers	3
ENERGY 141	Electrical & Mechanical Applications for Solar Installers	3
ENERGY 142	NABCEP Associate Certification Preparation	2
ENERGY 143	Solar Photovoltaic Systems Design, Installation, and Troubleshooting	4
Total Units:		16

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- describe the components in a complete grid-tie PV system.
- construct solar PV battery charging systems.
- analyze test equipment data to determine the location of the "sweet spot" on a solar PV panel's Current-Voltage (IV) curves.
- identify tools and test equipment necessary for solar PV panel installations.
- identify different sizes of wire according to American Wire Gauge (AWG) tables.
- analyze and describe the advantages of obtaining the NABCEP Associate Certificate of Knowledge Certificate.
- construct a simulated roof system using industry standard building materials.
- calculate the amount of yearly solar radiance in relationship to shading using the Solmetric's SunEye predictor and software.
- inspect and repair malfunctioning components in a functioning grid-tie solar PV system.
- assess safety hazards in respect to fire, shock, and falls when installing or repairing PV systems.
- estimate PV system using both the SunEye and the Pathfinder sun angle and shade predictor.
- identify typical locations of electrical/mechanical failures in PV systems.
- calculate the correct gauge wire and number of wires in a metal raceway according to National Electrical Code standards.
- calculate the battery amperage required for a stand-alone PV system.

Career Information

This certificate prepares the student for entry level employment in a wide variety of positions in the PV industry. It is also valuable for people working in the PV industry to upgrade their skills to include the newest advancements in solar technology. Career opportunities include PV installers, PV service technicians, and other emerging careers in this field.

Energy (ENERGY)

ENERGY 140 Electrical Applications for Solar Installers

Units:	3
Hours:	36 hours LEC; 54 hours LAB
Prerequisite:	None.
Corequisite:	ET 302

This is an introductory course in Solar Photovoltaic (PV) energy. It covers how solar PV energy works and how to assess if PV is feasible in a variety of situations. Topics include calculating and measuring PV power outputs for different conditions, using software tools and hardware for calculating and sizing PV systems, and measuring and analyzing shading conditions. Additionally, it addresses how to install and connect necessary components. Field trips may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- describe the components in a complete grid-tie PV system.
- construct solar PV battery charging systems.
- calculate the correct gauge wire for a given solar PV panel array.
- inspect and repair, if necessary, malfunctioning components in a grid-tie solar PV system.

- employ common hand tools in the mechanical installation of both a grid-tie and a battery solar PV system.
- analyze test equipment data to determine the location of the "sweet spot" on a solar PV panel's current-voltage (IV) curves.
- identify tools and test equipment necessary for solar PV panel installations.
- evaluate which different types of solar PV panels would have the most power output for a given application.
- assess safety hazards when working with PV systems.
- estimate the power output for a solar PV panel for a given sun angle.
- construct an electrical conduit that has both right and left 90-degree bends.
- identify different sizes of wire according to American Wire Gauge (AWG) tables.
- construct an emergency backup power system using solar PV panels and gel-cell batteries.

ENERGY 141 Electrical & Mechanical Applications for Solar Installers

Units:	3
Hours:	36 hours LEC; 54 hours LAB
Prerequisite:	ENERGY 140 with a grade of "C" or better
Corequisite:	ET 302

This is an advanced course in Solar Photovoltaic (PV) energy. Topics include using hardware and software tools for shading and correct orientation of solar panels, the effect PV panel orientation has on system power output and efficiency, what effect optimum PV panel loading has on power produced, and how to perform a load analysis on a residence. Additionally, it covers the use of various manufacturers' software to calculate PV panel string sizing for optimum efficiency when working with grid-tie inverters. National Electrical Code (NEC) and fire code wire sizing, fusing, and other safety instructions and procedures are stressed. The successful completion of this course and ENERGY 142 qualify students to take the North American Board of Certified Energy Practitioners (NABCEP) Associate Achievement Exam leading to the NABCEP PV Installation Professional Certificate. Field trips may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- analyze and describe the advantages of obtaining the NABCEP Associate Achievement Award and the PV Installation Professional Certificate.
- construct a simulated roof system using industry standard building materials.
- calculate the amount of yearly solar radiance in relationship to shading using the Solmetric's SunEye predictor and software.
- calculate the correct gauge wire and number of wires in a metal raceway according to NEC code standards.
- inspect and repair malfunctioning components in a functioning grid-tie solar PV system.
- employ common hand tools such as saws, drills, and framing squares used in building a simulated roof structure.
- analyze test equipment data to determine the voltage drop on low voltage, high current wires.
- attach solar PV panel mounting rails and associated hardware to a roof while retaining the ability of the roof to be watertight.
- evaluate the different types of solar grid-tie inverters and determine which configurations would have the highest efficiency and most power output for a given situation.
- assess safety hazards with respect to fire, shock, and falls when installing or repairing photovoltaic systems.
- estimate the yearly power output in watt-hours per year for a solar PV system using both the SunEye and the Pathfinder sun angle and shade

predictor.

- evaluate, draft, and construct a simple solar panel one-line drawing using graphics software.
- examine and classify different sizes of wire according to American Wire Gauge (AWG) tables.
- develop a solar PV panel string size using SMA America LLC. string sizing software and then modify the design for one half of the power output.

ENERGY 142 NABCEP Associate Certification Preparation

Units:	2
Hours:	36 hours LEC
Prerequisite:	ENERGY 140 and 141 with grades of "C" or better

This advanced course in solar photovoltaic (PV) energy includes preparation for the North American Board of Certified Energy Practitioners (NABCEP) PV Associate Certificate of Knowledge Exam. Topics include hardware and software tools used for determining percent of shade and orienting solar panels, the effect of PV panel orientation on system power and efficiency, and the load analysis. Additionally, it covers calculating PV panel string sizing when working with grid tie inverters as related to the NABCEP test. National Electrical Code (NEC) and fire code wire sizing, fusing, and other safety instructions and procedures are reviewed. The successful completion of this course and ENERGY 141 meets the requirements to take the NABCEP certified associate solar PV installers and service technicians entry level certificate of knowledge of PV systems test. Field trips may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- describe the advantages of obtaining the NABCEP PV Associate Certificate of Knowledge
- calculate the amount of yearly solar radiance in relationship to shading using the Solmetrics SunEye predictor and software
- calculate the correct wire gauge according to National Electrical Code standards
- analyze test equipment data to determine the voltage drop on low voltage, high current wires
- identify hazards involved with PV installation, maintenance, and troubleshooting
- calculate AC and DC current, voltage, and resistance in a given circuit
- use maps, compasses, and other instruments to determine true south
- identify key points on current-voltage (IV) curves
- describe the qualification tests for PV cells and modules
- describe the effect of cell temperature to PV panel output voltage and power
- calculate the battery amperage required for a stand-alone PV system
- calculate voltage drops in wiring, fuses, combiners, and connectors
- identify typical electrical/mechanical failures in PV systems

ENERGY 143 Solar Photovoltaic Systems Design, Installation, and Troubleshooting

Units:	4
Hours:	54 hours LEC; 54 hours LAB

Prerequisite:	ENERGY 141 with a grade of "C" or better

This advanced course in solar photovoltaic (PV) energy offers the opportunity for hands-on experience designing, installing, and troubleshooting grid-tie and stand-alone PV systems. Topics include hardware and software tools used in the solar PV industry, blueprint reading, calculating component size and capacity, and personal safety. Additionally, it covers calculating PV panel string sizing when working with grid-tie inverters and battery sizing when designing stand-alone PV systems. National Electrical Code (NEC) and fire code wire sizing, fusing, and other safety instructions and procedures are reviewed. Ten-hour Occupational Safety and Health Administration (OSHA) training is provided. Students must pay the OSHA required fee in order to obtain the OSHA safety card. Field trips may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- assess safety hazards when working with photovoltaic (PV) systems.
- evaluate which types of solar PV panels are best in various PV installations.
- employ common hand tools in the mechanical installation of both a grid-tie and a battery solar PV system.
- calculate the battery amp-hours required for a stand-alone PV system.
- construct solar PV grid-tie systems.
- interpret blueprint drawings and what their symbols represent.
- calculate the voltage and amperage of bi-modal PV systems.
- diagram fuses, combiner boxes, and disconnects in grid-tie and stand-alone PV systems.
- interpret NEC wiring codes for PV installations.
- calculate voltage drops for short and long distances.
- calculate the maximum number of wires allowed in a conduit using NEC tables.
- describe the benefits of solar incentives.
- resolve typical problems with solar PV systems.
- label all equipment and cable runs per NEC code.
- describe various energy sources that can be interfaced with photovoltaic systems.
- identify new career paths in the solar power industry.

ENERGY 303 Energy and Sustainability

Same As:	NATR 303
Units:	3
Hours:	54 hours LEC
Prerequisite:	None.
Advisory:	MATH 120, 125, 129, 133 or higher; NATR 300, or an equivalent transferable life science course; and Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300, OR ESLR 340 AND ESLW 340.
Transferable:	CSU
General Education:	AA/AS Area IV

This course investigates fundamentals of energy and impacts of energy systems on society and the environment. It explores energy resources, efficiency, conservation, and emerging technologies. Specifically addressed are mechanics, advantages, disadvantages, and sustainability of current and future energy

systems. This course also focuses on economic, cultural, political, and environmental aspects of energy production and consumption in the context of the built environment, transportation, food systems, manufacturing, and public services. Field trips may be required. This course is not open to students who have completed NATR 303 or ET 303.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- examine the concept of sustainability as it relates to energy
- examine geographic, socioeconomic, cultural, and environmental considerations of energy production and consumption
- explain technologies involved in solar thermal, solar photovoltaic, hydroelectric (large and small scale), nuclear fission, wave/current/tidal, geothermal, biomass, and wind (onshore and offshore) energy systems
- compare conventional fossil-fuel based energy systems with current alternatives
- examine the relationships between energy production and consumption scenarios and their contributions to atmospheric greenhouse gas concentrations and air, water, and soil pollution
- evaluate alternative energy policies for North America, Europe, and the world
- interpret the results of a residential energy audit and recommend actions
- critically evaluate more sustainable approaches and practices in energy use for heating, lighting, food systems, the built environment/transportation/infrastructure, manufacturing, and public services
- examine strategies for dealing with production and consumption fluctuations and energy storage issues
- understand considerations for energy systems related to temporal and spatial scale and connectivity, including potential for distributed energy systems, aging of the electrical grid, land use conflicts, and timelines for taking newer technologies to scale
- evaluate the potential for emerging opportunities in nanotechnology and biomimicry with respect to energy systems

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