COLLEGE OF THE DESERT

Course Code ESYS-312C

Course Outline of Record

1. Course Code: ESYS-312C
2. a. Long Course Title: Module 3 Residential Solar Installation
   b. Short Course Title: MOD 3 RES-SOLAR INST
3. a. Catalog Course Description:
   This entry level course is Module 3 of 3 for students interested in installing and maintaining photovoltaics systems and obtain a career in the solar industry. The installation principles, technics and functions of the photovoltaic will be presented along with installation and maintenance of all necessary components for a photovoltaic system. Discussion and instructions will also serve current solar installers wanting to earn industry recognized credential. Installation practices are aligned to help students prepare for the North American Board of Certified Energy Practitioners (NABCEP).
   The NABCEP PV Installation Professional certification is a voluntary certification that provides a set of national standards by which PV Installation Professionals with skills and experience can distinguish themselves from their competition. Certification provides a measure of protection to the public by giving them a credential for judging the competency of practitioners.

   b. Class Schedule Course Description:
   This entry level course is Module 3 of 3 for students interested in installing and maintaining photovoltaics systems and obtain a career in the solar industry.
   c. Semester Cycle (*if applicable*): *N/A*
   d. Name of Approved Program(s):
      - NEW CERTIFICATE IN PROGRESS Certificate of Completion
4. Total Units: 0 Total Semester Hrs: 36.00
   Lecture Units: 0 Semester Lecture Hrs: 36.00
   Lab Units: 0 Semester Lab Hrs: 0
   Class Size Maximum: 20 Allow Audit: No
   Repeatability Noncredit - Unlimited
   Justification 0
5. Prerequisite or Corequisite Courses or Advisories:
   Course with requisite(s) and/or advisory is required to complete Content Review Matrix (CCForm1-A)
   Prerequisite: ESYS 312B
6. Textbooks, Required Reading or Software: *(List in APA or MLA format.)*
   a. Dunlop,J.,P. (2012). *Photovoltaic Systems* (3rd/e). American Tech Publishers. ISBN: 9781935941057
   College Level: Yes
   Flesch-Kincaid reading level: 11.0
7. Entrance Skills: *Before entering the course students must be able:*
   a.
   Explain mechanical roof attachments and their load limitations.
      - ESYS 312B - Explain mechanical roof attachments and their load limitations. Satisfy SLO(1)

   b.
   Perform calculations on conductor ampacity and conductor derating factors.
      - ESYS 312B - Perform calculations on conductor ampacity and conductor derating factors. SLO(2)

   c.

List equipment needed for typical system performance analysis.

- ESYS 312B - List equipment needed for typical system performance analysis SLO(3)

8. Course Content and Scope:

Lecture:

1. PV System Sizing
1.1. Use of National Renewable Energy Laboratory (NREL's) photovoltaic (PV)-Watts
1.2. Analyze load demand for stand-alone and grid interactive service
1.3. Identify typical system electrical output de-rating factors
1.4. Calculate estimated peak power output direct current and alternating current
1.5. Calculate array and inverter size for grid-connected system
1.6. Calculate estimated monthly and annual energy output of grid-connected system
1.7. Explain relationship between array and battery size for stand-alone systems
1.8. Calculate array, battery and inverter size for stand-alone system
1.9. Explain Direct Current system output versus Alternating Current production

2. PV System Electrical Design

2.1. Determine series/parallel
photovoltaic (PV) array arrangement based on module and inverter specifications
2.2. Select Balance of Systems (BOS) components appropriate for specific system requirements
2.3. Determine voltage drop between major components
2.4. Perform design calculations using the 120% rule, the 125% rule, etc.
2.5. Perform calculations on conductor ampacity and conductor derating factors
2.6. Understand source circuits and output circuits
2.7. Understand usage of blocking diodes and bypass diodes
3. PV System Mechanical Design

3.1. Describe the relationship between row spacing of tilted modules and sun angle
3.2. Describe the mechanical loads on a photovoltaic (PV) array (e.g., wind, snow, seismic)
3.3. Describe various mounting methodologies
4. Performance Analysis and Troubleshooting
4.1. Describe typical system design errors
4.2. Describe typical system performance problems
4.3. Associate performance problems with typical causes
4.4. List equipment needed for typical system performance analysis
4.5. Compare actual system power output to expected
4.6. Identify typical locations for electrical/mechanical failure

Lab: *(if the "Lab Hours" is greater than zero this is required)*

9. Course Student Learning Outcomes:

1.
Demonstrate parallel and series circuit wiring during installations of solar systems.

2.
Employ test on solar systems to balance electrical loads.

3.
Calcualte current and voltage drop to verify size calculations.

4.
Apply electrical theory to obtain a passing score on the North American Board of Certified Energy Practitioners (NABCEP)

Entry Level exam.

10. Course Objectives: *Upon completion of this course, students will be able to:*
    a. Determine series/parallel PV array arrangement based on module and inverter specifications. Satisfy SLO(1)
    b. Select components appropriate for electrical balancing requirements during initial proposals . SLO(2)
    c. Perform calculations to determine and select the size of equipment needed for a simple family resident. LO(3)
    d. NABCEP training material will be introduce. Student will navigate through material and get familiar with calculations and formulas. SLO (4)

11. Methods of Instruction: *(Integration: Elements should validate parallel course outline elements)*
    a. Activity
    b. Collaborative/Team
    c. Discussion
    d. Lecture
    e. Participation
    f. Technology-based instruction

12. Assignments: *(List samples of specific activities/assignments students are expected to complete both in and outside of class.)*
    In Class Hours: 36.00
    Outside Class Hours: 72.00
    a. Out-of-class Assignments
       1. Read assigned text.
       2.Assigned worksheets.
    b. In-class Assignments
       1. Draw, explain and set up during lab series and parallel electrical circuits. SLO (1)
       2. Calculate electrical load balance. SLO (2)
       3. Calculate single family residence load demand SLO (3)
       Read and perform solar calculations SLO(4)

13. Methods of Evaluating Student Progress: *The student will demonstrate proficiency by:*
    - True/false/multiple choice examinations
    - Student preparation
    - Organizational/timelines assessment

    Be in-class on time. Have all assignments organize in 3 ring binder.

14. Methods of Evaluating: Additional Assessment Information:

15. Need/Purpose/Rationale -- *All courses must meet one or more CCC missions.*
    PO - Career and Technical Education
    Fulfill the requirements for an entry- level position in their field.
    Apply critical thinking skills to execute daily duties in their area of employment.
    Display the skills and aptitude necessary to pass certification exams in their field.
    IO - Scientific Inquiry
    Recognize the utility of the scientific method and its application to real life situations and natural phenomena.

16. Comparable Transfer Course

University System	Campus	Course Number	Course Title	Catalog Year

17. Special Materials and/or Equipment Required of Students:

18. Materials Fees: ☐ Required Material?

Material or Item	Cost Per Unit	Total Cost

19. Provide Reasons for the Substantial Modifications or New Course:

This course is developed to meet the goals of the California Energy Efficiency Strategic Plan (CEESP) which mandates that 100 percent of all new homes in California will be Zero Net Energy starting in 2020 and 50 percent of commercial buildings by 2030. Solar technology is the leading technology used to offset electrical demand from the power grid. California has acknowledged the shortage of qualified and available work force to meet these new mandates. The course is designed as employment preparation for all students wishing to enter the advanced energy industry.

20. a. Cross-Listed Course *(Enter Course Code)*: *N/A*
    b. Replacement Course *(Enter original Course Code)*: *N/A*

21. Grading Method *(choose one)*: Pass/No Pass Only

22. MIS Course Data Elements
    a. Course Control Number [CB00]: CCC000587546
    b. T.O.P. Code [CB03]: 94610.00 - Energy Systems Technology
    c. Credit Status [CB04]: N - Noncredit
    d. Course Transfer Status [CB05]: C = Non-Transferable
    e. Basic Skills Status [CB08]: 2N = Not basic skills course
    f. Vocational Status [CB09]: Clearly Occupational
    g. Course Classification [CB11]: J - Workforce Preparation Enhanced Funding
    h. Special Class Status [CB13]: N - Not Special
    i. Course CAN Code [CB14]: *N/A*
    j. Course Prior to College Level [CB21]: Y = Not Applicable
    k. Course Noncredit Category [CB22]: J - Workforce Preparation
    l. Funding Agency Category [CB23]: Y = Not Applicable
    m. Program Status [CB24]: 1 = Program Applicable

    Name of Approved Program *(if program-applicable)*: NEW CERTIFICATE IN PROGRESS
    Attach listings of Degree and/or Certificate Programs showing this course as a required or a restricted elective.)

23. Enrollment - Estimate Enrollment
    First Year: 20
    Third Year: 40

24. Resources - Faculty - Discipline and Other Qualifications:
    a. Sufficient Faculty Resources: Yes
    b. If No, list number of FTE needed to offer this course: *N/A*

25. Additional Equipment and/or Supplies Needed and Source of Funding.
    N/A

26. Additional Construction or Modification of Existing Classroom Space Needed. *(Explain:)*
    N/A

27. FOR NEW OR SUBSTANTIALLY MODIFIED COURSES
    Library and/or Learning Resources Present in the Collection are Sufficient to Meet the Need of the Students Enrolled in the Course: Yes

28. Originator Ramiro Galicia Origination Date 09/17/16