Sierra College
Environmental Studies & Sustainability
Division of Sciences & Mathematics

Spring 2013

SYLLABUS

COURSE TITLE: **Intermediate Photovoltaic Systems**
ESS 32

INSTRUCTOR:
Steve Geiger
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REQUIRED TEXT: **Photovoltaic Systems (Second Edition), by James P. Dunlop, PE and the National Joint Apprenticeship and Training Committee (NJATC),** American Technical Publishers, (ISBN # 978-0-8269-1308-1)

RECOMMENDED TEXTS: **Photovoltaics Design and Installation Manual, by Solar Energy International,** New Society Publishers, (ISBN # 978-0-86571-520-2)

National Electrical Code 2011, by National Fire Protection Association, Delmar Cengage Learning, (ISBN # 978-0877659143)

or

National Electrical Code 2011 Handbook, by National Fire Protection Association, Delmar Cengage Learning, (ISBN # 978-0877659167)

REQUIRED SUPPLIES: **Scientific Calculator** with exponential and trigonometric functions.
Approved Safety Goggles/Safety Glasses (they are required to be worn at all times in the lab).

COURSE DESCRIPTION:
Course builds on the fundamentals of solar photovoltaics with focus on system design and installation of grid-tied residential and small commercial systems. Topics include detailed system sizing, array layout, mounting techniques, mechanical and electrical integration, workplace safety, and electrical codes. This course will prepare students to sit for the NABCEP PV Entry-level Certificate of Knowledge Exam.

COURSE OBJECTIVES:

Objectives (lecture):

1. Outline proper safety procedures and precautions required for the installation and maintenance of photovoltaic systems.
2. Assess electrical service and distribution panel for sufficient capacity to add grid-tied solar photovoltaics per the National Electric Code.
3. Assess roof construction and effect on solar photovoltaic system design and mounting.
4. Illustrate effects of environmental conditions and series/parallel connections on the PV current-voltage (IV) curve.
5. Evaluate photovoltaic system configuration options using web-based and stand-alone software sizing tools.

6. Outline the mechanical loads on a solar photovoltaic array (e.g. wind, snow, seismic)
7. Outline purpose and operation of the major balance of system (BOS) components.
8. Calculate and assess voltage drop in a PV system.
9. Outline typical locations for electrical/mechanical failures.
10. Evaluate cost associated with each step of the solar photovoltaic design and installation process.
11. Analyze financial payback methods for PV installations.

Objectives (lab):

1. Employ proper safety practices and use of required personal protective equipment (PPE) for the installation and maintenance of PV systems.
2. Exhibit proper use of digital-multimeters, hand tools, power tools, and other equipment associated with PV system installation and maintenance.
3. Demonstrate proper use of ladders and fall protection equipment.
4. Evaluate optimal PV array location based on shading analysis.
5. Design, construct, and document series and parallel circuit sizes for given module, inverter, and temperature range specifications.
6. Compare features and benefits of different solar PV mounting techniques.
7. Evaluate key specifications of main electrical BOS components.
8. Design and construct PV array circuit wiring, grounding, and over-current protection according to the NEC requirements.
9. Outline equipment needed for typical system performance analysis.
10. Outline filed verification and performance diagnostic testing required upon completion of a PV system installation.

VI. PERFORMANCE CRITERIA:

Exams: Two exams worth 150 points each	300
Lab Activities / Projects / Homework	300
Quizzes	300
Class Participation	100
Total Points	**1000**

Course Grade	Point Range
A	900 -- 1000
B	800 -- 899
C	700 -- 799
D	600 -- 699
F	Less than 600
Incomplete	Only granted in very rare circumstances – please see college policy

A. **Student responsibility:** The *student* is responsible for meeting all requirements, prerequisites, deadlines, registration requirements and fees. Incomplete grades will not be given in lieu of poor course work or lack of attendance. Students are expected to be familiar with and to observe rules regarding honesty and plagiarism as outlined in the official college catalog.

B. **Exams:** Each exam will be drawn from textbook material and in-class lecture notes. NO MAKE-UP EXAMS WILL BE GIVEN. You may contact me in advance to request to take an exam early. If so, please be prepared to substantiate the necessity of your request in writing.

C. **Lab Activities:** Students will be assigned a number of hands-on lab activities throughout the semester. These activities will often be performed in groups, but also may be performed individually. Documentation of findings, processes, and methodologies will be required to be turned in to obtain credit for lab activities. No make-up labs will be allowed.

D. **Attendance and Participation:** It is very important that you attend class regularly to benefit from review of reading assignments, lab activities, and lectures. However, your involvement is most important because it gives you the chance to show support and caring for other students for working together in

your work teams. Your instructor will take attendance each session and keep track of those students who regularly participate in discussions, small group work, and contribute to a positive classroom environment. If you are absent from lecture five times or more during the semester, you will be jeopardizing your success in this course. Grades are partly based on in-class activities, which will occur *every* session (discussion, labs, quizzes, etc.). None of these activities will be repeated and none will be "made up," and none will be completed "at home," so excessive absences may result in a reduced or even failing grade. Being dropped from the class is not automatic; you will need to either contact me and let me know your intentions, or go to the Admissions and Records office and complete the drop procedure. **I will not drop you from the class without your telling me to do so.**

E. **Withdrawal:** Students must officially withdraw from courses in a manner approved by the college. Failure to withdraw properly *before the deadline* may result in an "F" grade. Consult an Official College Calendar for the last withdrawal date.

F. **Quizzes and homework:** Unannounced quizzes and homework may be given *frequently*. No make-up quizzes will be allowed without prior authorization and no homework will be accepted after its assigned due date. One quiz/homework grade will be dropped in calculation of final grade.

G. **Safety:** Students will be expected to promote a safe study and work environment. Everyone will adhere to prescribed safety procedures and follow basic electrical work and fall protection standards. Students will dress appropriately for lab and construction environments and will not be allowed to participate in activities if/when safety is compromised.

H. **Emergency Procedures:** Students should become familiar with the school's emergency procedures and classroom safety rules.

I. **Late Assignments:** You will be assigned due dates for all homework. In order to receive 100% credit for your graded work, you must turn in the assignments by the assigned due date. ***If you must be absent on the day of a presentation***, you must contact me in advance or as soon as possible and be prepared to submit written verification of your absence (i.e. doctor's note). ***If you must be absent on the date a written assignment is due,*** the assignment can either be turned in by the student or friend or fellow student, sent through the U.S. mail, or e-mailed to me. Late work must be made up within one week of the original due date, but will be automatically downgraded by 25%. Make-up work past this point will not be accepted, and will receive no grade.

J. **Incompletes:** On rare occasions, students need to request an incomplete grade for the semester. They are granted for unforeseeable, emergency, and justifiable reasons at the end of the academic term. (Typically, the student has accomplished at least 80% of the coursework for the semester.) If you encounter such a situation, contact me as soon as possible, and you will need to complete the appropriate paperwork available from Admissions and Records.

K. **Code of Conduct:** This course has opportunities for hands-on lab work with partners or in teams. You will be expected to handle yourself with the same professional conduct and courtesy that would be required of you by any employer or on any jobsite – in both the classroom setting, as well as the lab. Your professionalism, conduct and communication with fellow employees and your employer is an extremely important element of your future success in this industry.

Final Comments – My Objective:
This instructor has a goal to provide equal opportunity for success for all students. If you feel a learning disability might influence your successful completion of this course, please request a conference with the instructor during the first two weeks of the semester.

This instructor is pleased to accept suggestions regarding ways the class, labs, lectures, etc. may be made more fun, interesting, meaningful, and/or useful. Even though the essential content and required effort of the course cannot be diminished, all such suggestions will be carefully considered.

As your instructor, it is my objective to teach you the material in a dynamic and positive environment, as well as from personal first-hand experience. I like to teach in a synergistic and solution-oriented style. Your own motivation will help you succeed and excel in this class. I wish you the best for this semester.