AMERICAN RIVER COLLEGE

ENERGY DEPARTMENT

ENERGY 142

NABCEP (North American Board of Certified Energy Practitioners) Entry Level Test Review

Spring 2014

Course Title: **NABCEP (North American Board of Certified Energy Practitioners) Entry Level Test Review**

Course #: **13126** **Course Units:** 2

Instructor: Steve Geiger
Office hours TBA
Telephone number: 916-484-8354 E-mail: geigers@arc.losrios.edu

Prerequisite: ENERGY 141, Electrical & Mechanical Applications for Solar Installers grade of "C" or better

Hours: 36 hours LEC

Class Times: 1/21 - 2/13 TuTh 04:30 PM 08:45 PM Lec – Classroom: Tech Ed 321

Course Description: This advanced course in solar photovoltaic (PV) energy includes preparation for the North American Board of Certified Energy Practitioners (NABCEP) PV Entry Level 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 solar photovoltaic installers and service technicians entry level certificate of knowledge of PV systems test. Field trips may be required. This course may be taken two times for credit using different software.

Required Textbook: **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)

RAD Requirement: Reading and retaining information in this course is a critical requirement for passing the NABCEP (North American Board of Certified Energy Practitioners) beginning installation test. Therefore, enrollment in RAD (Reading Across the Disciplines) to improve skills in reading studying, and retention is highly advised.

Required Materials: A Scientific Calculator. All other Course materials will be furnished by the instructor.

Recommended Materials: Notebook, binder for handouts

Student Learning Outcomes & Objectives:

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

- describe the advantages of obtaining the NABCEP PV Entry Level 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

Evaluation Procedure:

Class Participation	50 Points
Homework	125 Points
Quizzes	125 Points
Portfolio of Projects	50 Points
Midterm/Final Exam/Oral Report/Project	150 Points
TOTAL	500 Points

Grading: The Final class grade will be based on a percentage of the total points (500) earned in the Course. Because of the complexity of the material, it essential to attend every class. See attendance policy (ARC) for grade lowering due to absences. (After two absences your grade is dropped one letter grade.) If the there is a problem with you missing a class, please contact me (leave a message) before the class to make other arrangements. All assigned lab projects must be completed for the student to earn a passing grade.

90%-100%	= A
80%-89%	= B
70%-79%	= C
60%-69%	= D
Below 60%	= F

Final: Thursday, Feb.13, 2014 Time: 6:30 PM – 8:45 PM

Dropping Classes: It is your responsibility to drop this course if you quit attending class. I will not drop you. Because the grading system is computerized, instructors are required to assign a letter grade for all students. Therefore, it is EXTREMELY IMPORTANT that you drop the class before the drop date so you won't receive an "F" on your transcripts. The drop date can be found in the college schedule.

ENERGY 142 Course Rules and Requirements:

Attendance Requirements – 2012-2013 Catalog:

(a) Per LRCCD Policy P-2222, students are expected to attend all sessions of the class in which they are enrolled.

(b) A student may be dropped from any class when that student's absences exceed six percent (6%) of the total hours of class time.

(c) Any student who is a no show shall be dropped from a class (CA Code of Regs., Title 5, 58004).

Note: Instructors must state in the class syllabus what constitutes excessive absences for that course.

Tardiness Policy:
The college does not have an official tardy policy. If the instructor wishes to implement a tardiness policy, it needs to be clearly stated.

Conduct and Behavior: Every college class is a learning environment. The college promotes and nurtures a safe environment for the free exchange of ideas and open expression of individuality and diversity within the bounds of courtesy, sensitivity, civility and mutual respect. The college practices the fundamental belief that every student has the right to a safe and respectful learning environment. Students should behave appropriately in class and show respect for classmates and the instructor. Examples of unacceptable behavior are yelling, moving about the classroom, talking during lectures or students presentations. The college prohibits sexist or racist remarks, and harassment of any kind. Students must turn off cell phones and other electronic devices during class. Students should not use I-Pods during class. Students should not wear headphone devices during class. Food and drinks are not allowed in classrooms.
Inappropriate behavior of any kind will be reported to the ARC Student Discipline Officer. Disruptive students may be suspended from class and are subject to more severe college disciplinary action, up to and including dis-enrollment, and suspension from the college. Any days spent in suspension from class are unexcused absences.
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Plagiarism: Material submitted by the student shall be created by that student. Any plagiarized or copied material will not be counted for credit and receive 0 Points for that assignment.

Special Needs, Health and Safety: "Students with health issues or disabilities that may necessitate intervention, academic accommodations, or modification to the college educational or physical environment are encouraged to arrange an appointment to discuss these issues with the professor so that a plan for meeting these needs may be established (Heath Center, March 2004)". DSPS# 484 8545 (Disabled Students and Services) provide support services to students who are identified by them as needing accommodations. Latex products may be used. If a student has a health issue related to latex, the student should discuss with the instructor so that accommodation can be made.

Personal Protective Equipment and Clothing: Safety glasses will be worn during the lab portion of the class whenever performing dangerous activities such as soldering and cutting/ stripping wires.

Safety: All students must successfully complete a safety test with a passing grade before using lab equipment and tools, or working in the lab. All injuries must be reported to the instructor immediately. A safety review will be done prior to working in the lab.

Lab Clean-Up Policy: Students are responsible for cleaning up their work station and surrounding area and returning tools and supplies to the tool room at the end of each class session. Under no circumstances try to attempt to repair lab test equipment.

Field Trips: Students must sign the "Agreement to Participate and Waiver/Assumption of Risk" Form and submit to the instructor in order to participate in each field trip. The instructor will retain a signed copy of each form and submit a duplicate set of forms to the dean's office.

Homework is due one week from the day that it is assigned.

Tests and Quizzes: Quizzes that are missed must be made up prior to the next class meeting unless prior arrangements have been made.

Late Work: All materials to be graded must be submitted on the date due unless prior arrangements have been made. Late assignments loose 10% per week after due date.

Reading Assignment(s): In addition to the handouts, there will be supplemental reading and web assignments required.

Outside Assignments: Homework assignments are required as part of your grade.

Health Issues or Disabilities: "Students with health issues or disabilities that may necessitate intervention or modification to the college educational or physical environment are encouraged to arrange an appointment to discuss these issues with the professor so that a plan for meeting these needs can be established. (Heath Center, March 2004)".

Supplemental Items: If you have an issue that requires special accommodations, let me know as soon as possible. There are many services on campus to assist students with their learning experience. It is recommended to seek help as early as possible when a problem arises. We can't help you if you don't ask.

Student Conduct Policies: Disruptive and inappropriate behavior will not be tolerated and may result in you being dropped from the class. Group learning is recommended; however, the lecture and lab tests are designed to test your individual knowledge of the material. So that means DON'T CHEAT!

Final and Progress Grades: Final grades will be available by college website or e-mail only. Grades will not be posted. Progress points will be available from the instructor and will be occasionally distributed.

Binders: It is a good idea to get a binder to keep the many handouts that you will be getting throughout the class. They are important and will be used as reference throughout your electronics career or can be sold at an exorbitant price on e-bay.

Methods of Instruction: The course material will be delivered by lecture, overheads, videos, textbook, supplemental reading and web-based assignments. Practical applications will be explored during hands-on demonstrations.

Cell Phones & Pagers: Phones and pagers interrupt the class and annoy fellow students. Please be considerate of others or they will be banned from the lab and lecture.

Food & Drink: **Food and Drinks are NOT** allowed in the Lab. Under no circumstances bring any food or drink into Room 323 because of Fiber Optic contamination of your food/drink.

Injuries: Notify the Lab Instructor immediately in case of injury.

Attendance Cessation: If you stop attending, it is your responsibility to contact e-services and drop the class. That way, the class will not be reflected on your transcripts.

Other Important Information: If you stop attending, it is your responsibility to contact e-services and drop the class. That way, the class will not be reflected on your transcripts. Use of appropriate language and sense of community—if behavior is disruptive to the class or the learning environment it is inappropriate. Latex products may be used in certain classroom activities. If a student has a health issue related to latex, the student should discuss with the instructor so that accommodation can be made.

- College Emergency Number is College Police at X2221 and from a cell phone at 558-2221
- All injuries must be reported to the instructor immediately.
- Safety glasses must be worn at all times when in the Lab (This is school policy)
- No food or drinks are allowed in the 323 Lab because of safety reasons (Fiber in your Coffee??) This means leave your backpacks, drinks and food someplace else!
- No playing around in the lab because of the cost of the equipment and safety issues

Final Comments / My Objective:
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.

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ENERGY 142: Semester Topic Outline

(May be modified due to semester time constraints)

Lec	Topic
3	Overview of the history of Photovoltaic (PV) technology, industry, and applications, different types of PV systems, importance of the NABCEP (North American Board of Certified Energy Practitioners) PV Entry Level Certificate of Knowledge Certificate, employment outlook for PV installers, technicians, and system designers.
3	Hazards involved with PV installation, maintenance, and troubleshooting, electrical safety when working with high current and high voltage systems, roof safety, hazards of operational and non-operational PV systems, general construction safety, proper use and applications of Personal Protective Devices (PPD).
2	Definitions of the terms and acronyms used in the PV industry, differences between energy and power, uses and operation of Digital Multi-meters, calculations of AC and DC current, Voltage, and resistance.
2	Application of the Sun Eye and Solarmetrics shade predictors, use of Solar Pathfinder and sun charts to predict shading, prediction of percentage of sunlight for various situations, using maps, compasses, and other instruments to determine true south, identify factors that reduce or enhance solar radiation.
3	Identification of key points on current—voltage (IV) curves, interpretation of manufacturers data sheets and specifications, explanation of the effect of environmental conditions on the IV curve, define the different measurement conditions for solar cells and modules, calculate the efficiency of various types of PV panels.
3	Calculation of PV panel output power under various weather conditions, the purpose of a blocking diode and a bypass diode, the effect of aging on PV panels and associated components, typical failures and PV cells and modules, describing the qualification tests and Underwriters Laboratories (UL) standards for PV cells and modules, describe the manufacturing process and the operation for each type of PV solar panel.
2	Comparing common PV panel mounting systems, comparison of PV mounting techniques and their advantages and disadvantages, effect of PV cell temperature to output voltage and power, major components of a grid tie systems and their function, overview of inverters, charge controllers, combiners, ground fault protection, batteries, and generators, when and where to install fuses and disconnects.
2	Calculating the power consumed by typical loads, interaction of typical loads with IV curves, de-rating AC and DC power systems, calculation of AC and DC peak power output, calculating savings in both power and dollars when using PV systems, calculating battery storage size for a stand-alone PV system.
3	Utilizing load-sizing software and analyzers, determine proper PV panel Wattage, determine series/parallel PV array arrangement based on module/inverter specifications, calculate grid tie inverter to PV panel size, calculate voltage drops in wiring, fuses, combiners, and connectors.
2	Determining the correct PV panel mounting brackets for a given roof structure, determine row spacing of tilted PV modules used on flat roofs, calculating wind, snow, seismic, and other mechanical loads on a PV panel array, choosing the correct PV panel mounting hardware, typical mounting hardware installation errors.
4	Overview of installer safety, proper procedures for safe PV system installations, troubleshooting PV systems, typical PV system design errors, test equipment necessary for PV system performance analysis.
2	Comparison of PV system calculated output power to actual power output, typical problems encountered when repairing PV systems, commissioning and proofing PV systems, identification of typical locations of electrical/mechanical failure, failure analysis for PV systems.
3	Identifying federal, state, and local utility incentives and rebates, determining the documentation and commissioning necessary for receiving incentives and rebates.
2	Final exam