Course Syllabus

Engr 499 Alternative Energy Engineering Project Course
MW 3:30 PM - 5 PM
Fall, 2011

The course will be taught by Prof. Alice Parker (parker@eve.usc.edu EEB 348, 213-740-4476), along with Prof. Katherine Shing (shing@usc.edu) and Dr. Gordon Roesler (gmr@isi.edu), office hours Parker: By Appointment until Sept, then 2-3 PM Mon and Thurs.  
TA: Suvil Deora, office hours TBD

Prerequisites: Junior standing in the Viterbi Engineering Honors Program or permission of the instructor

Course motivation and description: Alternative energy is an interdisciplinary topic that involves virtually every aspect of engineering along with some aspects of science. In order to understand the field, diverse knowledge must be acquired from multiple sources. This course is experimental because none of the instructors can possess complete knowledge of this rapidly-expanding field, and so the instructor-as-guide model applies very well

Underlying this situation is the transition from the model of the instructor imparting knowledge to the students to a model of the instructor guiding the students in knowledge acquisition obtained from many sources. Active learning will develop students’ capabilities to continue life-long learning. The students will use the Internet extensively in their project/research work, and will use online collaboration tools for their project work.

This course is designed to allow teams of students freedom to choose a direction of study, while simultaneously exposing them to hands-on construction, in-depth research, and overall experience with the broader aspects of an engineering project. The course is inspired by Olin College’s Design based engineering approach, see interview with Rick Miller, President. Rick says "In design based (engineering) you don't even give students the problem. They have to define what it is that's important to do before they can start doing anything. That's where creativity comes in." The instructors will suggest areas of exploration, and will provide some structured exercises, but assisting the students in finding the engineering problem in an array of challenges is also part of the course experience. In addition to mastering course content, goals for the students are to develop initiative, responsibility, understanding of relevant ethics, decision making in the presence of uncertainty, negotiation, and advocacy, risk assessment, decision making, resourcefulness and flexibility in the context of the subject matter, solar energy.

Intended Audience: The course is appropriate for ALL junior and senior engineering majors. Undergraduates in the Engineering Honors program have priority in enrolling. Other
undergraduates can enroll with permission from the instructor. This class may be counted as a technical elective.

Graduate students can assist the teams of undergraduates by enrolling in directed research, attending class, participating in discussions, performing in-depth research on selected topics, and presenting their research at class meetings.

**Course Activities:** The students will fabricate and test a solar panel with individual solar cells. The students will then split into two teams to design and construct electric vehicle charging stations. After the team project, the students will form small project groups to research directions of interest to each group. Team members can apply to the faculty to be team leaders for their group. Team Leaders will be tasked with promoting in-group collaboration, and helping maintain the scope and direction of the group’s research. They will also ensure the accountability of individual group members. Guest lecturers will address topics related to the research directions of the small groups. The end result will be a project report and presentation. Small quizzes will be scheduled frequently to encourage student preparation for the classroom discussions. The quizzes may utilize the on-line Blackboard software to avoid using class time.

Expected Course Outcome: The students will possess a general familiarity with solar energy technology, and be able to read and understand technical magazine articles and textbooks at their academic level. Students will be able to demonstrate specific expertise in project areas so that they will be able to continue independent study or research in their chosen area. Students will be able to assemble small photovoltaic (solar) stand-alone facilities. Students will be able to make tradeoffs between size, power production, cost, weight and other considerations. Finally, students will develop skills in the practice of independent inquiry to support their areas of interest, including effective use of Internet resources and engineering design skills.

**Week 1 Lecture 1** Solar “boot camp” - Rapid immersion in commercial solar technologies
Readings: Chapter 1, Messinger Text, Internet pages - Lecture by Parker

**Week 1 Lecture 2** Rapid Immersion continues - solar panel construction project begins
Readings: Chapter 2, Messinger Text, Internet pages - Lecture by Parker

**Week 2 Lecture 3** Rapid Immersion continues, solar panel construction project completed
Readings: Chapter 3 Sections 3.1-3.5 Messinger Text - Lecture by Parker

**Week 2 Lecture 4** Rapid Immersion concludes. Quiz on solar technologies
Readings: Chapter 3, Sections 3.6-3.10 Messinger Text - list of competencies covered - Lecture by Parker


**Week 3 Lecture 5** Introduction to engineering design approaches: System Engineering: multi-criteria design, cost functions, optimization strategies; begin charging station project initial designs (2 teams)
Readings: Chapter 4, Messinger Text - Lecture by Parker

Note - Monday is Labor Day - no class - hence there is only one lecture in Week 3.

**Week 4 Lecture 6** Engineering design approaches continued; discussion of possible course directions; continuation of charging station project designs
Readings: Chapter 4 Messinger Text - Lecture by Roesler on Spider and engineering design

**Week 4 Lecture 7** Alternative energy mileaux: Economics, regulatory environment, government incentives, building codes, environmental issues, rate structures, and other considerations. Readings: Chapters 8 and 9, Messinger Text - Outside lecturers

**Week 5 Lecture 8** Survey of commercial alternative energy approaches: solar, thermal, wind, and others. - ocean waves- geothermal Lecture by Roesler

**Week 5 Lecture 9** Presentation of charging station designs, begin charging station construction. 
Readings: Chapter 4 Messinger Text

**Week 6 Lecture 10** Survey of solar cell technologies; presentation of charging station designs; discussion of future course direction - Outside lecturer
Readings: Chapter 11, Messinger Text

**Week 6 Lecture 11 through Week 14 Lecture 28:** Charging station final projects will be presented during this time. Lectures will be drawn from the list of topics below (and others suggested by course participants that are appropriate):

Research in Advanced Topics - for example:
- solar cell fabrication,
- solar installation design software,
- solar installation control software
- smart grid/distribution systems
- energy saving devices and techniques
- Possible Guest lecturers Lu, Zhao, Dapkus, Madukar
- Projects with business, environmental, political and/or social considerations
- Projects with a design focus -
  - design a possible solar installation for a university building (RTH)
  - follow up on electric vehicle design
  - solar decathlon design
● Lift on roofs caused by wind - aerodynamics - stress analysis - Aerospace, Civil and Mechanical Engineering considerations - Chapter 5 Messinger Text
● Computer control - embedded system software/hardware Computer Science/Engineering
● Solar cell fabrication - chemical engineering/material/science/device fabrication Chemical Engineering, Material Science, Electrical Engineering
● Solar installation design - electrical and mechanical engineering
● CAD software for solar design to make engineering tradeoffs - computer science/computer engineering
  ○ Environmental issues - panel manufacturing, heat and light reflection - Civil/Environmental Engineering and Biomedical Engineering
● Safety issues
● Installation weight on roof structures - Civil Engineering - Chapter 5 Messinger Text
● Project management - Industrial Engineering
● Solar power for medical devices - Biomedical and Electrical Engineering
● Synthetic photosynthesis/genetic engineering/synthetic biology
● Alternative energy - wind turbines, geothermal, solar heating
● Frugal engineering, engineering for change, local energy production
● Role of Alternative Energy in the whole energy supply landscape

Readings will be drawn from relevant sources, depending on student interest.

**Week 15 Lectures 29 and 30** Small Group Project Presentations


**Suggested readings:** The boy who harnessed the wind


Photovoltaic Systems, James P. Dunlop, In partnership with NJATC, Amer Technical Pub, 2009


and others, including selected websites (e.g. Technology Review, published by MIT)

Grading:
Quizzes based on the readings: 15%
Solar basics quiz: 15%
Solar panel construction and presentation: 12%
Solar charging station construction and presentation 23%
Small group research project and presentation 35%.

**Statement for Students with Disabilities**
Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to faculty (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

**Statement on Academic Integrity**
USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one’s own academic work from misuse by others as well as to avoid using another’s work as one’s own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.