ENGR 650 Solar and Renewable Energy Utilization

Instructor: Ravi Subramanian, Associate Professor, Dept. of Chemical Engineering
Location: LME 309 (University of Nevada, Reno)
Phone: 775-784-4686
Email: Please use the WebCampus Email tool to contact Prof. Subramanian
Office Hours: Online by appointment

Course Description

This course provides a basic overview of all the ways in which solar energy can be used. It will be an “all you need to know about solar energy” one-stop content for a broad audience of students, teachers, professionals, and entrepreneurs. Students can compare and obtain a perspective of fundamental physical insights, chemistry aspects of solar energy conversion, and engineering potential - all in one course. Students will also gain a perspective of the broad gamut of development related to each solar energy area from this course through ample references and reading materials.

Prerequisite: ENGR 600 Alternative Energy Fundamentals is recommended preparation for this course.

Course Objectives

ENGR 650 students will:
• Develop a knowledge and understanding about the various types of processes that utilize solar energy.
• Apply simple mathematical skills to derive expressions useful to examine material properties and understand light-matter interactions.
• Understand the basic physics of the process, chemistry of the materials, and engineering applications of the materials and system.
• Study about and compare the different processes that utilize solar energy.
• Learn about techniques to evaluate optical, electronic, surface, and catalytic properties of the materials and understand their potential applications in the context of solar energy.
• Develop an awareness of the current state-of-the-art commercial and pilot scale systems used for harvesting solar energy.
• Briefly examine the benefits and drawbacks of solar energy with other forms of energy such as wind, nuclear, geothermal, etc.
Student Learning Outcomes

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

• Describe various solar energy utilization processes.
• Compare and describe the similarities and differences in the processes that utilize solar energy.
• Compile and evaluate materials for their properties and their potential application to solar energy.
• Describe current state-of-the-art systems used for harvesting solar energy.
• Apply mathematical skills to derive expressions useful to study material properties.
• Compare solar energy with other forms of alternate energy technologies.

Course Material

Four basic articles will be provided as the “core reading materials” or the primary equivalent of a textbook. Segments from these articles will be taught over the duration of this course. Additional content will be uploaded on an as-needed basis to supplement the content of the articles. There is no required textbook for this course.

Core reading materials


Links to additional reading material will be posted on an as needed basis. These may be journal articles, specific websites, YouTube videos, etc. It is the student’s responsibility to make sure they have access to institutional resources such as library access.

Course Technology

Technical skills: Operating an Internet browser with multimedia options. WebCampus and many of its tools will be used for online course delivery and participation.

Equipment: Scientific calculator for some basic problem solving, access to plotting and interpretation software, such as Microsoft Excel; a scanner to upload hand-written assignments. Photos of hand written-work are also acceptable.

© Copyrighted by Subramanian, University of Nevada, Reno
Online Discussion Requirements

You are required to submit at least one original response to the weekly discussion question and respond to at least two classmates’ posting each week. I will occasionally intervene to answer specific questions and to steer the conversation in the right direction, but as graduate students, you are expected to self-learn as much as possible. A discussion grading rubric is posted on WebCampus on the Syllabus page.

To ensure that this class has time to develop a good discussion by the end of the week, you should adhere to the following schedule:

<table>
<thead>
<tr>
<th>Type of Discussion Post</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Discussion Post</td>
<td>Wednesday 11:59pm PST</td>
</tr>
<tr>
<td>Response to at Least One Classmate’s Discussion Post</td>
<td>Sunday 11:59pm PST</td>
</tr>
</tbody>
</table>

Course Evaluation and Grading Procedures

Course Grading: Your final grade will be based on:

- **Assignments = 30%**
  One written assignment will be given for each of the first 9 weeks.

- **Discussions = 10%**
  A discussion grading rubric is posted on WebCampus in the Modules section (Student Guides for Modules).

- **Quizzes = 30%**
  Three objective-type quizzes will be given during the course (worth 10% point each). You may use notes on these quizzes.
  - Quiz 1 in Week 4 (covering weeks 1-3),
  - Quiz 2 in Week 7 (covering weeks 4-6), and
  - Quiz 3 in Week 10 (covering weeks 7-9).

- **Case Study = 25%** (description provided below)

- **Final Exam (Case Study Summary) = 5%**

Case Study: For your case study, you will identify a topic from Weeks 5 – 9. You may select a topic from examples that I will provide or you may select a topic of your own choosing. You must select your topic by the end of week 9 (Nov. 6th) and have it approved by me. The case study must be submitted on or before Dec. 4th.

Final Exam (Case Study Summary): In order to pass the course, you are required to write an summary of your final project during a proctored exam session administered by ProctorU. You may not use any notes, online references, or other resources to write the summary. The proctored exam session requires an Internet connection with a webcam, microphone, and speakers. The proctored session fulfills the University's requirement to verify your identity as the student registered for this course. The summary should be no more than 500 words and you will have two hours to write it. Detailed instructions will be provided within the WebCampus course site.
Grade Scale: Final course grades will be based on the following scale:

<table>
<thead>
<tr>
<th>Points</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥90</td>
<td>A</td>
</tr>
<tr>
<td>≥80</td>
<td>B</td>
</tr>
<tr>
<td>≥70</td>
<td>C</td>
</tr>
<tr>
<td>≥60</td>
<td>D</td>
</tr>
<tr>
<td>Anything below 60</td>
<td>F</td>
</tr>
</tbody>
</table>

Student Expectations: As this is a graduate level course, it is expected that you come into the course with individual initiative, self-motivation and interest in the topic of solar energy. It is highly recommended that you log into WebCampus at least three times a week to read and review the week’s content, to participate in discussions, and to submit assignments. Expect to spend a minimum of 6-8 hours a week learning the weekly content and completing the weekly assignment and discussions. Successful completion of an online course requires that you schedule your online access and participation just as you would schedule attendance and study time for a face-to-face course. If you do not have a strong math background, please do not worry; It is not required for successful completion of this course.

Instructor Expectations: As an instructor for this course, my responsibilities include providing engaging and relevant material to discuss, direction and feedback on ideas presented in discussions and assignments, and treating each student with fairness and respect. Grades and feedback on assignments will be provided in the week following the submission of the assignment. I welcome feedback at any time throughout the duration of the course (contact through the WebCampus Email tool). I will respond to your feedback and will make every attempt to make changes based on reasonable feedback.

Academic Honesty: Individual responsibility is one of the key aspects of independent learning. It is important that the student adhere to a personal code of ethics in the completion of the course lessons. Discussion of the lesson materials with other students is encouraged, but all work submitted must be your own. Anyone caught violating this university regulation will be subject to disciplinary action as stated in the Academic Standards section of the General Catalog at the University of Nevada, Reno. A violation may result in your failing the course.

Civility: Students are expected to conduct themselves in a civil manner at all times and in all forums. Students are responsible for contribute to the maintenance of a campus environment that fosters intellectual curiosity and diversity. That means respectful
engagement with differing opinions and views. Harassment of one individual by another—in person, via e-mail or in electronic discussions—is uncivil behavior, which discourage the open expression of ideas on academic subjects. Online and Independent Learning and the university are committed to an orderly learning environment that protects the right of free speech, and do not tolerate personal intimidation of any kind.

**Class Conduct:** With recommendation of the instructor and approval of the college dean students may be dropped from class at any time for negligence or misconduct. Students may also be dropped for non-attendance upon indication of the instructor. Non-attendance in an online class consists of one or more of the following: Not logging into the WebCampus course on at least a bi-weekly basis, not working on and submitting assignments on a weekly basis and not participating in discussion questions by the dates assigned.

**Audio and Video Recording:**
Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded.

**Equal Access:** The Disability Resource Center at the University of Nevada supports the provision of equal access to students with disabilities. Any student with a disability needing academic adjustments or accommodations is requested to contact the Jill Wallace, jwallace@unr.edu, or the Disability Resource Center at the University of Nevada, Reno, as soon as possible to arrange for appropriate accommodations.

Disability Resource Center/0079
University of Nevada, Reno
Reno, NV 89557
(775) 784-6000
http://www.unr.edu/drc/
## Course Outline:

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic, Quizzes, Final Exams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Week 1: Fundamentals of Solar Energy Processes</td>
</tr>
<tr>
<td>Week 2</td>
<td>Week 2: Historical Aspects of Earlier Attempts and More Recent Applications</td>
</tr>
<tr>
<td>Week 3</td>
<td>Week 3: Materials and Synthesis Aspects Related to Solar Energy</td>
</tr>
<tr>
<td>Week 4</td>
<td>Week 4: Techniques for Examining the Properties of Materials for Solar Energy Conversion</td>
</tr>
<tr>
<td></td>
<td>Quiz 1 (covers weeks 1-3)</td>
</tr>
<tr>
<td>Week 5</td>
<td>Week 5: Solar to Electric Conversion</td>
</tr>
<tr>
<td>Week 6</td>
<td>Week 6: Environmental Remediation</td>
</tr>
<tr>
<td>Week 7</td>
<td>Week 7: Solar Fuels</td>
</tr>
<tr>
<td></td>
<td>Quiz 2 (covers weeks 4-6)</td>
</tr>
<tr>
<td>Week 8</td>
<td>Week 8: Solar Driven Bio-chemical Processes</td>
</tr>
<tr>
<td>Week 9</td>
<td>Week 9: Solar Thermal Processes</td>
</tr>
<tr>
<td>Week 10</td>
<td>Week 10: Examples of Commercially Operating Systems</td>
</tr>
<tr>
<td></td>
<td>Quiz 3 (covers weeks 7-9)</td>
</tr>
<tr>
<td>Week 11</td>
<td>Weeks 11-13: Case Study</td>
</tr>
<tr>
<td></td>
<td>Note that this the Weeks 11-13 module ends on Dec. 2 FRIDAY, which is also the due date for the Case Study paper.</td>
</tr>
<tr>
<td>Week 12</td>
<td>Week 14: Final Exam (Case Study Summary)</td>
</tr>
</tbody>
</table>

**NOTE: DISSEMINATION OF COURSE MATERIALS/CONTENT – CONTENT MAY NOT BE DISSEMINATED IN PART OR WHOLE WITHOUT WRITTEN INSTRUCTOR PERMISSION.**