Syllabus

SEC 501: Solar Engineering and Commercialization - I

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Course Intent
The Professional Science Masters program in Solar Energy Engineering and Commercialization (PSM-SEEC) is a program that has been established and developed to help meet the "Energy Engineering" mandate in the National Academy of Engineering Grand Challenges. This course, Solar Engineering and Commercialization – I, is designed to be the introductory building block in the PSM-SEEC program.

Course Participants and Prerequisites:
The course is designed for graduate students in the science, technology, engineering, and mathematics (STEM) fields with a strong interest in solar energy systems and their role in the technological society. Competence in upper-division engineering, mathematics, materials, and problem-solving skills is expected. Although some review of semiconductor materials, electronics, etc. will be given in class, the student must be able to fill in knowledge gaps as needed. It is a required class for students in the PSM-SEEC program.

Enrollment requirements:
Prerequisites: Graduate Engineering Students
Antirequisite: SEC 598 Solar Engineering and Commercialization I

Course Description:
This course examines the fundamentals of the solar energy enterprise regarded from a systems engineering perspective. The course examines solar energy technology, economic issues, and policy matters, and reviews the impact of these three areas on the design process and system operation of photovoltaic systems at the residential and commercial scales. The course educational objectives for the participants include:

• Learning the basic principles in photovoltaic system design
• Thinking critically and seriously about the nature of solar energy and its use
• Formulating views and insights regarding energy resources, conservation, photovoltaic economics, government subsidies, etc.
• Expressing and defending these views orally and in writing

The course includes lectures, case studies, interactive classroom projects and guest speakers.
Course Learning Outcomes
Upon completion of this course, students will be able to

- Apply the engineering design process to the development of PV systems at the residential and commercial scales
- Characterize the solar market for residential systems and its methods of finance and applicable permitting and regulations.
- Value the role of policy (local, state, and federal) in solar development and commercialization
- Identify the impact of their designs in a global and societal context
- Demonstrate their knowledge of design and effective communication by carrying out and presenting two class projects related to contemporary solar energy issues

Course Texts and Resources:
The reading materials are found on various websites. The National Renewable Energy Labs, the Energy Information Administration, the Department of Energy and other facilities have extensive libraries available for free at their websites. The trade journals and the daily news feeds are received by email and the students must subscribe to these resources online, but there are no subscription fees.

- Various web resources (National Renewable Energy Laboratory, Energy Information Administration, etc.)
- Various trade journals (SolarPro, PV Magazine, etc.)
- Daily PV news sources (Greentech Media, Utility Dive, Advanced Energy Economy, etc.)

Course Deliverables:
A normal array of brief quizzes (most every class), homework sets (bi-weekly), and two class projects. All of the work (apart from the quizzes) will be carried out in a team format, as cooperative learning is expected and encouraged.
The student teams have approximately four weeks to carry out the **Midterm Project** (topic defined by the instructor), and the deliverables are a student report in memorandum format and a classroom Powerpoint presentation delivered by all of the team members.
The student teams have approximately six weeks to carry out the **Final Project** (topic defined by the student team, approved by the instructor), and the deliverables are a student report in formal report format, a brief classroom Powerpoint presentation delivered by all of the team members. All of the student teams participate in a poster presentation of their work on the Final Project.
Grading Components:
- Quizzes (Daily) – 15%
- Assignments (Biweekly) – 25%
- Midterm Project (Week 09) – 25%
- Final Project (Final Exam Period) – 35%

The grade the students receive on the projects is based on both team effort and individual contributions. At the end of each project, each student must submit a short evaluation document describing both their individual contributions to the project, and the value of their contributions to the success of the project. The evaluation document employs the “salary distribution method,” in which each student has “bonus money” to divide among all the participants, including the student himself/herself. Each student must justify in writing the reasons for the “bonus values.” The individual grades are adjusted by considering the evaluation document and the oral presentation scores.

Grading Scale
A+ = 97.0-100  
A = 93.0-96.9  
A- = 90.0-92.9  
B+ = 87.0-89.9  
B = 83.0-86.9  
B- = 80.0-82.9  
C+ = 77.0-79.9  
C = 70.0-76.9  
D = 60.0-69.9  
E = <60

Course Format:
The class schedule, assignments, solutions, class presentations, etc., will be posted only on a class webpage.

Weekly Course Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Energy and Power; Electricity Generation Overview</td>
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<tr>
<td>2</td>
<td>The Solar Resource</td>
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<tr>
<td>3</td>
<td>PV Systems – Solar Cells and Solar Modules</td>
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<tr>
<td>4</td>
<td>PV Systems – Batteries, Electronic Control Devices, Balance of Systems</td>
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<tr>
<td>5</td>
<td>Class trip to Solar Power International conference</td>
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<tr>
<td>6</td>
<td>PV Systems – Electronic Control Devices, Balance of Systems</td>
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<tr>
<td></td>
<td>PV System Design Overview; Standards and Codes</td>
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<tr>
<td>7</td>
<td>Economic Analysis Overview</td>
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<td>8</td>
<td>Solar Policy Overview</td>
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<tr>
<td>9, 10</td>
<td>Residential Scale PV Systems – Engineering</td>
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<tr>
<td></td>
<td>- Stand-alone</td>
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<td></td>
<td>- Grid-Connected</td>
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<td></td>
<td>- Grid-Connected with Battery Storage</td>
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</table>

Midterm Project Due
11 Residential Scale PV Systems – Business
- Economic Considerations
- Financing
12, 13 Residential Scale PV Systems – Policy
• Utility and Public Utility Corporation Interactions
• State and National Overview
• Value of Solar and General Rate Case Examples

14 Community Solar Overview

15, 16 Commercial and Industrial Scale PV Systems

Final Project/Presentations Due
**Classroom behavior policies:**
- Cell phones must be silenced during class and students should refrain from answering or making phone calls and sending text messages during lectures. If they must do so, they will need to leave the classroom without disrupting the lecture and come back after they are done.
- Laptops should not be open during lectures.
- No recording devices of any kind can be used.
- Behavior that disrupts the lectures is not acceptable and students who engage in such behavior will be asked to leave.
- Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

**Absence policies:**
- Attendance to the lectures is required. If you miss any class, it will be your responsibility to obtain notes for the missed lecture.
- Make-up exams will be given for absences that are due to religious observances/practices that are approved by university policy or due to other events or activities sanctioned by the university (ACD 304–04, “Accommodation for Religious Practices” and ACD 304–02, “Missed Classes Due to University-Sanctioned Activities.”). In those cases, the student must notify the instructor in advance (preferably 1 week ahead for the midterm) so that arrangements can be made.
- If an absence is not due to a university-sanctioned reason, missed exams will not be made up unless it is due to health issues (a doctor note will be required), or a personal emergency that is appropriately justified. Arrangements need to be made within 1 week following the absence, including a meeting with the instructor to provide justification for it. If there is no attempt on the part of the student to make these arrangements in this time frame, the missed exam will receive zero points.

**Academic integrity and plagiarism policies:**
All students in this class are subject to ASU’s Academic Integrity Policy (available at http://provost.asu.edu/academicintegrity) and should acquaint themselves with its content and requirements, including a strict prohibition against plagiarism. All violations will be reported to the Dean’s office, who maintain records of all offenses. Students are expected to abide by the FSE Honor Code (http://engineering.asu.edu/integrity/).
Disability resources:
- Students who require accommodation for a disability must be registered with the Disability Resource Center (DRC) and submit appropriate documentation from the DRC and appropriate arrangement will be made.
- Students who plan to make these arrangements should inform the instructor at the first convenient opportunity at the beginning of the semester to facilitate the process.

Sexual Discrimination

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish to discuss any concerns confidentially and privately.