

Mechanical Engineering (ME) 612: Sizing Solar Energy Systems

Catalog Description: (2016 – 2017 Catalog) Covers the sizing of solar thermal and photovoltaic systems using various types of software. Design criteria are also covered. Required course for the technical branch of the solar and renewable energy graduate certificate.

Prerequisites: Graduate standing

Co-requisites: None

Credits: 3 **Contact Hours:** 3 (Lecture)

Course Coordinator: Robert Boehm (Isaac Mahderekal)

Course Learning Outcomes: At the conclusion of this class, students will be able to

- **Correctly describe and evaluate the performance of photovoltaic and solar thermal engineering systems** and how they apply to local and national needs,
- **Develop building energy simulations** using building energy simulation software packages,
- **Successfully complete preliminary designs of PV and solar thermal systems** and predict their performance.
- **Correctly perform cost analyses of the systems** and use this information in system design.
- **Be able to correctly conduct preliminary design of storage and grid connection systems** for residential applications.

Course Objectives: This course is structured to introduce students to the fundamentals of solar energy conversion systems, available solar energy and local and national needs, photovoltaic and solar thermal engineering applications, emerging technologies. Students will also learn the interdisciplinary approach for designing PV and solar thermal systems, and will learn how to conduct building energy simulations using building energy simulation software packages. They will also learn how photovoltaic energy conversion systems are integrated into electrical grid systems, including generation, storage, and grid connection processes for residential applications.

Brief List of Topics Covered:

1. Home Energy Use and Assessment
2. eQuest energy simulation tool
3. EnergyPlus energy analysis and thermal load simulation
4. Solar Radiation
5. Tracking systems and solar radiation sensors
6. Meteorological data analysis
7. Solar Photovoltaic (PV) Technology Basics
8. Solar PV sight assessment and Installation Guidelines
9. Solar PV modeling
10. Introduction to Solar Thermal Systems
11. Solar Thermal System Modeling
12. Economic feasibility assessment methods

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Supplemental Information: In this course, students gain practical knowledge of designing residential-scale solar photovoltaic (PV) and thermal systems. Main topics include basic physics related to solar energy, ways of harvesting solar energy, sizing a PV system, sizing a solar thermal system, energy storage vs. grid-tie, system components, installation techniques, economic feasibility assessment methods and safety

Textbook: **Solar Engineering of Thermal Processes,** 4th Edition, John A. Duffie & William A. Beckman ISBN: 0-471-69867-9

Other Supplemental Materials:

- eQuest energy simulation tool tutorial and manual:
http://doe2.com/download/equest/eQ-v3-64_Introductory-Tutorial.pdf
- EnergyPlus energy analysis and thermal load simulation tool tutorial and manual:
<http://apps1.eere.energy.gov/buildings/energyplus/pdfs/gettingstarted.pdf>
- National Renewable Energy Laboratory (NREL) PVWATTS Calculator:
<http://pvwatts.nrel.gov>
- System Advisor Model (SAM) manual:
<https://sam.nrel.gov/sites/sam.nrel.gov/files/content/documents/pdf/sam-help.pdf>
- Transient system simulation program (TRNSYS) manual:
<http://www.trnsys.com/assets/docs/03-ComponentLibraryOverview.pdf>
<http://web.mit.edu/parmstr/Public/Documentation/01-GettingStarted.pdf>
- **Photovoltaic Systems**, 2nd Edition, by James P. Dunlop, ISBN 978-0-8269-1287-9. ©July 2009 National Joint Apprenticeship and Training Committee and American Technical Publishers:
- Photovoltaics Design and Installation Manual, ISBN 978-0-86571-520-2. ©2007 Solar Energy International, New Society Publishers: www.solarenergy.org

Library Resources

- Students may consult with a librarian on research needs. For this class, the subject librarian is Sue Wainscott.
(https://www.library.unlv.edu/contact/librarians_by_subject). UNLV Libraries provides resources to support students' access to information. Discovery, access, and use of information are vital skills for academic work and for successful post-college life. Access library resources and ask questions at <https://www.library.unlv.edu>.

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Academic Misconduct—Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy and are encouraged when

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faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution.

An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: <https://www.unlv.edu/studentconduct/student-conduct>.

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Disability Resource Center (DRC)—The UNLV Disability Resource Center (SSC-A 143, <http://drc.unlv.edu/>, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

Religious Holidays Policy—Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor within the first 14 calendar days of the course for fall and spring courses (excepting modular courses), or within the first 7 calendar days of the course for summer and modular courses, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit: <http://catalog.unlv.edu/content.php?catoid=6&navoid=531>.

Transparency in Learning and Teaching—The University encourages application of the transparency method of constructing assignments for student success. Please see these two links for further information:

<https://www.unlv.edu/provost/teachingandlearning>

<https://www.unlv.edu/provost/transparency>

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Incomplete Grades—The grade of I—Incomplete—can be granted when a student has satisfactorily completed three-fourths of course work for that semester/session but for reason(s) beyond the student’s control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving “I” grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

Tutoring and Coaching—The Academic Success Center (ASC) provides tutoring, academic success coaching and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, visit <http://www.unlv.edu/asc> or call [702-895-3177](tel:702-895-3177). The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of the SSC (ASC Coaching Spot). Drop-in tutoring is located on the second floor of the Lied Library and College of Engineering TEB second floor.

UNLV Writing Center—One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 702-895-3908. The student’s Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>.

Rebelmail—By policy, faculty and staff should e-mail students’ Rebelmail accounts only. Rebelmail is UNLV’s official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students’ e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu. **Emailing within WebCampus is acceptable.**

Final Examinations—The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: <http://www.unlv.edu/registrar/calendars>.