

EE 446/646 – Photovoltaic Devices and Systems

Course Syllabus

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Office Hours: T & TR: 11:00-12:00 and 1:30-2:30, M: 11:00-12:00

Required Book: Gilbert M. Masters, Renewable and Efficient Electric Power Systems, 2nd Edition, Wiley, ISBN 978-1-118-14062-8

Recommended References:

1. Applied photovoltaics, S.R. Wenham, 2007
2. Third generation photovoltaics: Advanced Solar Energy Conversion, M.A. Green, 2006.
3. Polycrystalline thin-film photovoltaics : from the laboratory to solar fields, B. von Roedern, H.S. Ullal, and K. Zweibel, 2006
4. Photovoltaics : design and installation manual : renewable energy education for a sustainable future - Solar Energy International
5. Organic photovoltaics : concepts and realization , C.J. Brabec, 2003
6. Photovoltaic systems / James P. Dunlop, 2010
7. Multijunction photovoltaic technologies for high-performance concentrators [electronic resource] : preprint / R. McConnell and M. Symko-Davies, 2006
8. Photovoltaic incentive design handbook / T.E. Hoff, 2006
9. Photovoltaic Solar Energy Generation / by H.K.V. Lotsch
10. Modeling photovoltaic systems using PSpice / Luis Castañer and Santiago Silverstre
11. IEEE Photovoltaics Specialists Conference Proceedings

Course Content:

- **Renewable Energy Systems (Chap. 8):** direct solar power conversion (PV), concentrating solar power, wind power, hydro power, biomass, geothermal power, ocean power,
- **The Solar Resource (Chap. 4):** solar spectrum, sun position, sun path diagrams, solar and clock times, clear sky insolation on a collecting surface, solar radiation measurements, resource of solar data.
- **Photovoltaic Materials (Chap 5):** semiconductor physics, photovoltaic materials.
- **PV Electrical Characteristics (Chap 5):** equivalent circuit of a PV cell, modules and arrays, I-V curves, impact of temperature, shading impacts.
- **Grid-Connected PV Systems (Chap 6):** I-V Curves of simple loads and batteries, interfacing with the utility, system sizing, economic considerations.

- **Stand-Alone PV Systems (Chap 6):** load estimation, batteries and their properties, array and battery sizing, hybrid-PV systems, case study of PV-powered water pumping.
- **Other Related Topics:** National Electric Code (NEC), IEEE Standard 1547, industry trends, etc ...

Course Outcome:

Students should be able to:

- Locate the sun position at any given location and time, interpret sun path diagrams, analyze solar insolation on a collecting surface, and measure solar radiation measurements.
- Understand the inner workings of p-n junctions, determine a circuit model of a PV cell, PV module and PV array, measure and interpret I-V curves, understand the impact of temperature and solar insolation on I-V curves, have a broad knowledge on different types PV technologies and their limitations.
- Determine the operating point of basic electrical loads connected directly to a PV module or array.
- Design a grid-connected PV system, including the PV array and balance of system (BOS), conduct an economic analysis, and be familiar with the impact of high PV penetration on the utility grid.
- Have basic knowledge on different types of batteries and their electrical characteristics.
- Design a stand-alone PV system by estimating the load, sizing and selecting the batteries, sizing and selecting the PV modules, charge controller and inverter.
- Have basic knowledge on material properties of array mounting systems, forces acting on PV arrays, and design and installation guidelines,
- Have basic knowledge on codes and standards associated with PV Systems (i.e., the National Electric Code (NEC) and IEEE Standard 1547).

Computer Useage:

PV-Watts, Excel

Tests:

		Value
Midterm	Covers first half of course material	25 Pts
Projects	TBA	25 Pts
Quizzes	Once a week (on average)	25 Pts
Final	Covers all course material	25 Pts
Total		100 Points

Grading:

A ≥ 100 > B ≥ 80 > C ≥ 60 > D ≥ 45 > F

Notes:

- Graduate students will be given more challenging test questions, and individual projects.
- Homework will be assigned but not collected. Everyone is encouraged to do the assigned homework problems - some of the test and quiz problems will be similar.
- There will be no make-up tests or quizzes.
- There will be no extra credit work for individuals.
- Class attendance and participation is highly encouraged.

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 Academic Misconduct Policy and are encouraged when 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.

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UNLV complies with the provisions set forth in Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. The DRC is located in the Student Services Complex (SSC-A), Room 143, phone (702) 895-0866, fax (702) 895-0651. For additional information, please visit: <http://drc.unlv.edu/>.

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 no later than the first two weeks of classes of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. This policy shall not apply in the event that administering the test or examination at an alternate time would impose an undue hardship on the instructor or the

university which could have been avoided. For additional information, please visit:
<http://catalog.unlv.edu/content.php?catoid=4&navoid=164>.

Tutoring – The Academic Success Center (ASC) provides tutoring and academic assistance for all UNLV students taking UNLV courses. Students are encouraged to stop by the ASC to learn more about subjects offered, tutoring times and other academic resources. The ASC is located across from the Student Services Complex, #22 on the current UNLV map. Students may learn more about tutoring services by calling (702) 895-3177 or visiting the tutoring web site at:
<http://academicsuccess.unlv.edu/tutoring/>.

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 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.