• Photovoltaic power systems
• Power conversion and control electronics

Prerequisite: ECEN 4797 or ECEN 5797
Spring 2014 Instructors

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Spring 2014 Lab Sections

- 5517-011: Tuesday 12-3:50pm
- 4517-011: Wednesday 12-3:50pm
- 4517-012: cancelled, move to Tuesday or Wednesday
Experiments

1. Introduction to PV systems, battery characteristics, direct energy transfer
2. Introduction to TI MSP430 microcontroller
3. Buck DC-DC converter for maximum power point tracking (MPPT) and battery charge control
4. Step-up 12-200V DC-DC converter
5. Single-phase DC-AC inverter
   Expo: complete system demonstration
Experiment 1
Introduction to PV systems

- Model PV panel
- Investigate direct energy transfer system behavior
- Investigate effects of shading
- Observe behavior of lead-acid battery
Experiments 2 and 3
Maximum Power Point Tracking

- Design and construct dc-dc converter
- Employ microcontroller to achieve maximum power point tracking (MPPT) and battery charge control
Experiments 4 and 5
Add Inverter to System

- Build your own inverter system to drive AC loads from your battery
- Step up the battery voltage to 200 VDC as needed by inverter
- Regulate the 200 VDC with an analog feedback loop
- Change the 200 VDC into 120 VAC
ECEE Expo: ECEN4517/5517 Lab Competition

- Operate your complete system
- Competition during ECEE Expo: capture the most energy with your system outside

Previous year’s competition poster
Lab Format

Two-person groups, up to 10 groups per section
This week: lab organizational meetings
Parts kits:
  • One kit needed per group
  • Contains power and control electronic parts needed for experiments
  • Available from E Store; cost: around $160
  • You will also need other small resistors etc. from undergraduate circuits kit
Lab: room ECEE 1B65
  • Access via CUID card reader
  • Computer login via CU Identikey
  • You may optionally store your parts in your own locked drawer in your lab bench. Lock and key deposit for the semester at E Store.
Lab Work and Grading

Your course grade will be based on the following:

- Prelab assignments (group)
- Lab final reports (group)
- Quizzes: online and in-class (individual)
- Expo (group)
- Attendance and lab performance (individual)

Weightings for assignments are listed in the course D2L site
Late work will not be accepted

Course D2L site

- Lab modules: slides, videos, on-line quizzes
- Upload of prelabs and reports to appropriate D2L dropbox folders
- All due dates and all grading
Lab reports

• One report per group. Include names of every group member on first page of report.
• Report all data from every step of procedure and calculations. Adequately document each step.
• Discuss every step of procedure and calculations
  – It is your job to convince the grader that you understand what is going on with every step
  – Interpret the data
  – Clearly annotate waveforms and circuit diagrams, include figure captions
  – Concise is good
  – Regurgitating the data, with no discussion or interpretation, will not yield very many points
  – Messy work will not receive credit
Upcoming assignments

This week: brief lab orientation meeting in the lab

Experiment 1: Intro to PV Systems, direct energy transfer
  • View Exp 1 modules and do online quizzes on D2L by 12pm Jan 21
  • Do Exp. 1 in the lab next week, Jan. 21-22
  • Exp. 1 report due in D2L dropbox by 6:00 pm on Friday Jan. 31.

Experiment 2: Intro to MSP430 microcontroller
  • View Exp 2 modules and do online quizzes on D2L by 2pm Jan 27
  • Do Exp. 2 in the lab during week of Jan. 28-29
  • Exp. 2 report uploaded to D2L dropbox by 6:00 pm Friday on Feb. 7

Experiment 3: Buck MPPT converter … etc. see schedule on D2L and the course website
Experiment 1: Intro to PV Systems

Characterize the SQ-85 PV panels, and find numerical values of electric circuit model parameters for use now and later in the semester

Examine effects of shading

Observe operation of lead-acid battery

Test the inverter provided

Charge the battery from the panel, using the Direct Energy Transfer method

Work to be done:

- View Exp 1 modules and do on-line quizzes on D2L by 12pm Tuesday, Jan.21
- Experiment 1 to be performed next week (Jan.21-22): hope for sun!
- Final report for Exp. 1 due in D2L dropbox by 6pm on Friday, Jan 30

In case of bad weather (<250W/m2 irradiance): Exp 1 Lab page on the course website provides instructions on how to proceed
ECEN4517/5517 PV Cart

PV panel
- 85 W_{pk}
- 17.2 V at 4.95 A
- Shell SQ-85P

Battery
- 12 V
- deep-discharge 56 A-hr

Inverter
- 60 Hz 300 W
- 120 Vrms

6 outlet ac power strip

Alarm
Battery low voltage

Voltmeter
Battery voltage

Isolated dc-dc converters
- +12V, 1A
- -5V, 2A

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