University of Delaware

Department of Electrical and Computer Engineering

ELEG620: Solar Electric Systems

Syllabus Spring 2008

Sources of Information:

University of Delaware course catalog website: http://chico.nss.udel.edu/CourseDesc/
My course website: http://www.ece.udel.edu/~honsberg/eleg620.html

Introduction:

Photovoltaics systems generate electrical power directly from solar energy using semiconductor devices called solar cells. Photovoltaic systems are a rapidly increasing method of generating electric power directly from sunlight. These increases are driven not only by the increasing value of the technical advantages of photovoltaics systems, but also by remand and interest in residential roof-top programs. The goal of ELEG620 is that students understand the operation of photovoltaics devices, systems and applications.

Assumed Knowledge:

- Steady-state electric circuits, including non-linear elements such as diodes.
- Knowledge of atomic structure consistent with Intro Chemistry and Intro Physics.
- Mathematical knowledge: up to and including second order linear differential equations.
- Understanding of basic solid state physics (no quantum physics). Semiconductor devices is helpful, but material is reviewed in class.

Class Times

Tuesday. Thursday: 3:30 -4:45 pm 204 Evans Hall

Instructors:

Christiana Honsberg, Rm 201 Evans Hall
Allen Barnett, Rm 201 Evans Hall
TA and TA Office hours: TBD

Email and web policy:

- Notes and information about class will be posted to the website. Please use this as your first resource for information. I expect that you would check it at least once per week.
- If the website doesn't answer you questions and you wish to email me, please use a subject heading which clearly identifies ELEG620, or it may be deleted by the spam filter.
- Please do not email me on very short notice (i.e. one hour before a homework or project is due) and except a response.

Textbooks

The key resource for the class is a web-based textbook available at http://www.udel.edu/igert/pvcdrom/ . In addition there are several textbooks useful as references. Some of these are listed below.

- *Solar Electricity, 2nd Edition*, by Tomas Markvart (Editor): A good general purpose lower level photovoltaic textbook. (Watch the title carefully – the author has also edited other solar cell books).

- *Solar cells: Materials, Manufacture and Operation*, edited by T. Markvart and L Castaner. An extraction of selected chapters from a longer handbook, focusing on physical mechanisms and solar cell technologies.
- *Photovoltaic Solar Energy Generation* (Springer Series in Optical Sciences) by Adolf Goetzberger and Volker U. Hoffmann: A slightly higher level photovoltaic textbook, more emphasis on solar cell operation. Focus is more on survey that detailed operation.
- *The Physics of Solar Cells* (Properties of Semiconductor Materials) by Jenny Nelson (Jul 2003). As the title implies, this book focuses on solar cell operation rather than systems, but gives the best in-depth (which includes quantum effects) coverage of solar cells.
- *Photovoltaic Systems Engineering*, Second Edition, by Roger A. Messenger. Good book focusing primarily on systems.

There are also several classic textbooks, which are out of print but can still be found used.

- *Solar Cells: From Basic to Advanced Systems*: by Chemming Hu, R.M. White. A good general purpose textbook, covering both solar cells and systems.
- *Solar Cells:* Martin A. Green: (Careful of the title –there are several titles by M. Green). A good general purpose textbook, covering both solar cells and systems, updated more recently than Hu and White.
- *Solar Cells:* J Hovel: An older book giving a good overview of solar cell operation.
- *Fundamentals of Solar Cells: Photovoltaic Solar Energy Conversion* (Hardcover, 1983), By Alan L. Farrenbruch, Richard H. Bube. Classic in-depth textbook on solar cells, but hard to find.
- *Solar Cell Device Physics* (1983): Stephen J. Fonash. Good in-depth analysis of solar cells, also relatively hard to find.

Grading

Homework	10 Homework units, each worth 4%	40%
Quizzes	2 Quizzes, each 15%	30%
Class Notebook		5%
Projects		25%
TOTAL		100%

Homework

There are 10 homework "units" associated with the class, with each one being worth 4%. Some homework assignments will be worth one unit, and some of the longer ones will be worth two. In total, there are 7 total assignments.

Class Notebook

Regular review of class material is important for developing an understanding of material. To facilitate this, and also get you in the habit of keeping effective notebooks, you will be asked to keep a class notebook. I will break 5 minutes before the end of class, and this time will be used for you to write down the three main points covered in class. At the beginning of the next, class I will ask you to review the main points, and ask if there are any questions. The notebooks will be collected periodically (every 3 weeks), to check that you are keeping a class notebook. The content will not be examined – the goal is the write to notes that are useful to you.

	Date	Lecture Material	Quizzes	Assessment Due
Wk 1	Feb 12	Introduction; Systems Overview		
	Feb 14	Solar Radiation		
Wk 2	Feb 19	Solar Radiation		
	Feb 21	No Class		HW 1: Solar Radiation (2 units)
Wk 3	Feb 26	Semiconductor Basics		
	Feb 28	Semiconductor Basics; PN Junctions		HW #2: Basics and Junctions
Wk 4	Mar 4	PN Junctions		
	Mar 6	Solar Cells		HW #3: Solar Cells
Wk 5	Mar 11	Solar Cells		
	Mar 13	Solar Cell Design		
Wk 6	Mar 18	Joint CEEP Lecture		HW #4: PC1D design (2 units)
	Mar 20	Solar Cell Technologies		
Wk 7	Mar 25	Solar Cell Technologies/Efficiency Limits		HW #5: Grid Design (2 units)
	Mar 28	Quiz #1	Quiz #1	
	April 1	Spring Break		
	April 3	Spring Break		
Wk 8	April 8	PV System Basics & Design		
	April 10	PV System Basics & Design		
Wk 9	April 15	System Components: PV Modules		
	April 17	System Components: PV Modules, Batteries		
Wk 10	April 22	System Components: Batteries		HW #6: Systems
	April 24	System Components; Chargers, Inverters		
Wk 11	April 29	System Components; Inverters, BOS		
	May 1	Applications and Economics of PV Systems		
Wk 12	May 6	Applications and Economics of PV Systems		
	May 8	System Analysis and Reliability		HW #7: Economics
Wk 13	May 13	Quiz #2	Quiz #2	
	May 15	PV Systems Lab		
	May 20	Project Report due		
		Final: TBD		