ECE 5832: Photovoltaics and Energy Conversion

Course Description

Photovoltaic materials and devices; solar cell device physics; solar cell simulation, design and operation; silicon cell technologies; thin film technologies; III-V technologies; nanostructures; terrestrial and space applications.

Prior Course Number: 835.01
Transcript Abbreviation: Photovoltaics
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Junior, Senior, Masters, Doctoral
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Odd Years
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 3030, or Grad standing in Engr or Physics.
Exclusions: Not open to students with credit for 835.01.
Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Master understanding of semiconductor physics for photovoltaics
Master solar cell device physics
Master solar cell operations, design, and limitations
Be competent with advanced solar cell designs such as multijunctions

Be competent with solar cell equivalent circuits
Be familiar with system implementation of solar cells

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Photovoltaics, global energy issues and the solar spectrum	2.0							
Optical properties of photovoltaic materials	3.0							
Electronic and transport properties of photovoltaic materials	5.0							
PN junction transport under solar illumination	4.0							
Solar cell spectral response and output parameters	2.0							
Solar cell simulations	2.0							
Non-idealities, material parameters and practical cell design	3.0							
Solar radiation and theoretical conversion efficiency limits	2.0							
Crystalline silicon solar cell technology	2.0							
Thin film technologies	3.0							
III-V multijunction and concentrator technologies	3.0							
Nanostructure approaches	2.0							
Space photovoltaics	3.0							
Characterization of solar cells	2.0							
In-class presentations	3.0							

Representative Assignments

Several homework assignments
Two or three midterm examinations
Final examination

Grades

Aspect	Percent
Homework	15%
Three midterm examinations	60%
Final examination	25%

Representative Textbooks and Other Course Materials

Title	Author
Solar Energy: The Physics and Engineering of Photovoltaic Conversion Technologies and Systems	Arno Smets, Klaus Jager, Olindo Isabella, Rene van Swaaij, and Miro Zeman

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.

Course Contribution		College Outcome
*	c	An ability to design a system, component, or process to meet desired needs.
	d	An ability to function on multi-disciplinary teams.
**	e	An ability to identify, formulate, and solve engineering problems.
*	f	An understanding of professional and ethical responsibility.
	g	An ability to communicate effectively.
**	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
*	i	A recognition of the need for, and an ability to engage in life-long learning.
***	j	A knowledge of contemporary issues.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
*	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
*	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
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Additional Notes or Comments

Updated prereqs, exclusions, goals and topics to conform to university format 3/29/12

Change title of course to "Photovoltaics and Solar Energy Conversion" 2/18/14
Change course number from 7832

Changed semester of offering to autumn odd. 3/23/15. CED

Update foals, assignments, grading.

update goals to match university choice of working 7/6/16 BLA

Update course goals, new textbook, and mark contributions to new ABET outcomes per Sp19 review. 5/28/19 GJV

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