ECE 5237 (Proposed): Photovoltaics Laboratory

Course Description

Introduction to laboratory techniques for processing and fabrication of inorganic and organic solar cells, and photovoltaic testing and measurement techniques to characterize solar cells.

Transcript Abbreviation: PV Lab
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Junior, Senior, Masters, Doctoral
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 4.0
Repeatable: No
Time Distribution: 3.0 hr Lec, 3.0 hr Lab
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 MSE 3271, and enrollment in ECE or MatScEn major; or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.
Exclusions:
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

Introduce the student to the basic techniques for fabrication and measurement of photovoltaic cells
Learn computer tools for simulation of photovoltaic cell characteristics
Apply knowledge learned in prerequisite semiconductor devices courses to the fabrication and evaluation of PV cells and test structures
Obtain practical experience with contact and series resistance, spectral sensitivity, open circuit voltage, short circuit current, and quantum efficiency of photovoltaic devices and test structures by application to the devices fabricated in lab

Obtain practical experience with extraction of device parameters from and analysis and interpretation of solar cell measurement and test results
Obtain experience with cleanroom procedures, and with safe use of the hazardous materials and equipment used in photovoltaic device fabrication

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Solar energy and photovoltaic technologies, Lab safety, Overview of class PV processes	3.0							
Inorganic solar cell device physics	2.0							
Ohmic contact technologies for inorganic solar cells	3.0							
Inorganic solar cell design and simulation tools	3.0							
Electrical and optical parasitic losses	3.0							
Photovoltaic measurement techniques	6.0							
Cleanroom orientation, safety protocols and inorganic wafer introduction			3.0					
Inorganic solar cell mesa patterning			3.0					
Mesa etching and oxidation for inorganic solar cell			3.0					
Front side metal patterning of inorganic solar cell			3.0					
Front side metal deposition			3.0					
Backside metallization and anneal			3.0					
Inorganic solar cell testing - illuminated I-V, quantum efficiency, cell performance parameters			6.0					
Organic cell electrode patterning and etching			3.0					
Successive depositions of the organic layer stack followed by metalization			3.0					
Encapsulation	3.0		3.0					
Organic solar cell testing - illuminated I-V, quantum efficiency, cell performance parameters			6.0					
Organic semiconductor materials	3.0							
Organic semiconductor materials deposition techniques	3.0							
Organic semiconductor device architectures	4.0							
Optical and electrical properties of organic materials	4.0							
Testing and calibration of organic solar cells	3.0							

Representative Assignments

Several homework assignments based on solar cell theory and laboratory processes
Weekly laboratory reports
Solar cell simulation assignments
Final inorganic solar cell report compiling laboratory activities, observations and the results of device characterization
Final organic solar cell report compiling laboratory activities, observations and the results of device characterization

Grades

Aspect	Percent
Homework assignments	10%
Simulation Reports	25%

Aspect	Percent
Inorganic PV Cell Report	30%
Organic PV Cell Report	30%
Lab Technique	5%

Representative Textbooks and Other Course Materials

Title	Author
Lab manual	

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.
**	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.

Additional Notes or Comments

UPdate prereqs, goals and topics to match university format

Add MSE 3271 to prereqs, increase to 4 credits, 3 hours lecture and 1hour lab. Topics and times need to be updated to match new credit hours. BLA 3/13/17

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