Rutgers University, Department of Electrical and Computer Engineering
COURSE NUMBER: (to be announced) 14:332:xxx and 16:332:xxx
INTRODUCTION TO SOLAR CELLS: SYLLABUS
Instructor: *Dr. Alessia Polemi*
alessia.polemi@rutgers.edu

Course Catalog Description: 14:332:xxx and 16:332:xxx (3credits)

Course schedule: Mondays, 5pm-8pm

Course location: EE 203

Office hours: Mondays, 3.30pm-4.30pm, ECE #113

Pre-Requisite Courses: 14:332:465 Physical Electronics suggested but not mandatory. The instructor will review fundamentals of semiconductor physics

Co-Requisite Courses: None

Textbook & Materials: Antonio Luque and Steven Hegedus, Eds., *Handbook of Photovoltaic Science and Engineering, 2nd Ed.*, Wiley (2011).

References:
S. Fonash, Solar cell device physics, Academic Press, *2nd Ed* (2010)

S.O. Kasap, Principles of Electronic Materials and Devices, McGraw-Hill Science/Engineering/Math (2005) {basics on semiconductors}

S. O. Kasap, Optoelectronics and photonics: principles and practices, Prentice-Hall, (2001) {basics on solar cell}

Website: http://pveducation.org

J. Nelson, *The Physics of Solar Cells*, Imperial College Press (2003).

P. Wurfel, *Physics of Solar Cells, 2nd Ed.*, Wiley (2009).

A. Fahrenbruch and R. Bube, *Fundamentals of Solar Cells: Photovoltaic Solar Energy Conversion*, Academic Press (1983).

Extra reading will be provided by the instructor.

Overall Educational Objective:

This course focuses on the physics and processing of solar cells: charge excitation, conduction, separation, and collection. It will cover semiconductor materials, basic semiconductor physics, optical and electronic phenomena (conversion efficiencies, loss mechanisms), characterization, manufacturing, and systems. Both standard and emerging solar cell technology is described, including crystalline silicon, thin film, and nanostructured photovoltaics. Photovoltaics will be discussed in a global context. The course is interdisciplinary and of potential interest to undergraduate and graduate students in ECE and other departments. Students will also use simulations to design solar cells.

Course Learning Outcomes. A student who successfully fulfills the course requirements will have demonstrated:

1. An understanding of basic operation of solar cells and their current and potential role in the global energy portfolio.
2. An understanding of semiconductor physics relevant for more detailed understanding of photovoltaic device function.
3. Familiarity with various solar cell technologies such as Si, CdTe, nanostructured solar cells, and the benefits and limitations of each.

How Course Outcomes are assessed:

Attendance (5%)
Homework (including simulations) (15%)
Midterm (25%)
Research topic + presentation (25%)
Final exam (30%)

Tentative schedule: please not that the schedule can be changed by the instructor along the course, depending on students enrollment and background.

DATE	CONTENT
jan 26th	Introduction to Photovoltaics: achievements and challenge
feb 2nd	Fundamental Properties of Semiconductors
feb 9th	Solar Cell Fundamentals
feb 16th	New-generation Solar Cells, Crystalline Silicon Solar Cells
feb 23rd	wxAMPS software, High-efficiency III-V Multijunction Solar Cells
mar 2nd	Space solar cells, Concentrators
mar 9th	MIDTERM
mar 16th	Crystalline Silicon Thin-Film Solar Cells. RESEARCH TOPIC ASSIGNED
mar 23rd	BREAK
mar 30	Crystalline Silicon Thin-Film Solar Cells, Amorphous Silicon-based Solar Cells
apr 6	Cadmium Telluride Solar Cells, Dye-sensitized Solar Cells and Organic Solar Cells
apr 13	Transparent Conducting Oxides for Photovoltaics, Characterization of Solar Cells and Modules
apr 20	Case study: Shockley paper

apr 27	IN CLASS PRESENTATIONS
may 4th	Photovoltaics and nanostructures
may 7th-13th	FINALS

Course website: available through Sakai

Homework: Instruction for each homework will be available through Sakai.

Midterm: The instructor will notify if the exam is open notes or not.

Final: The instructor will notify if the exam is open notes or not.

Research topic + presentation: Each student (or groups, depending on enrollment) will be assigned with a paper on solar cell from literature, on different aspects of photovoltaics. The students will read the paper and present in class the outcome of that paper, also referring to other papers on that topic that are considered appropriate and better explain the concept. The students are also encouraged to propose their own ideas and possible future development. This will increase the evaluation of their assignment and could possibly lead to future Capstone projects.

Assignment of letter grades:

90-100%	A
85-89%	B+
80-84%	B
75-79%	C+
70-74%	C
60-69%	D
<60%	F

All grades will be distributed to students through Sakai.