14:635:405
"Solar Cell Design and Processing"
Fall 2013

Registration number: 32145

Meeting Times:
Wednesday, 12:00 – 1:20
Friday, 1:40 – 3:00

Instructor:
Dunbar P. Birnie, III, Professor
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Design Content:
This class will be heavily design oriented. We will focus on solar power from the large system level down to the nanoscale device engineering level. Often this will lead to design optimization discussions allowing us to understand the variables under our control and aspects where improvement can be achieved.

Grading:
Design Projects and Homework (sometimes Individual or Small Team): 60% total
Mid-Term Test: 20%
Final Exam: 20%

Office Hours:
Best by appointment - arranged by email (dunbar.birnie@rutgers.edu).

Class Website:
Lecture Material, homework assignments, grading, information handouts and other information will be shared through a class SAKAI site.

Technology Emphasis:
Among the design projects and lecture materials there will be a strong emphasis on entrepreneurism and innovation related to solar technology and utilization. This will include examination of patent literature and current events news items that relate to solar technology

Technical Material Coverage:

I. Array and System Practical Issues (~10%)

A. The Sun's Motion and Seasonal Variations
B. Array Placement, Tilt, Installation
C. Inverters and Power Generation
D. Solar Hot Water Heaters

II. Photovoltaic Device Operation (~40%)

A. The Available Solar Spectrum
B. Absorption of Light by Matter
C. Material Electronic Structure: The Band Gap
D. p-n Junction Formation and Internal Fields
E. p-i-n Structures
F. Motion of Electrons and Holes
G. Generation and Recombination Processes
H. Macro-Electrical Characteristics

III. Relevant Semiconductor Processing (~30%)

A. Diffusion, Oxidation
B. Photolithographic Patterning
C. Evaporation, Sputtering
D. Solution Deposition Techniques
E. Heterojunction Devices
F. Ohmic Contacts,
G. Transparent Conductors
H. Metallization
I. Series Resistance Effects

IV. Optical Effects and Advanced Topics (~20%)

A. Anti-Reflection (AR) Coatings
B. Refraction and Non-Normal Illumination
C. Textured surfaces for Light Trapping
D. Dual- and Multi-Junction Cells
E. Novel alternative Systems – Dye Sensitized and Organic Cells
F. Nanorod Solar Cells