

ECE Course Outline

ECE6456 - Solar Cells (3-0-3)

Prerequisites: None

Corequisites: None

Catalog Description: To provide a practical understanding of semiconductor materials and technology as it relates to design and development of efficient solar cells and photovoltaic systems.

Textbook(s):

Green, *Solar Cells: Operating Principles, Technology and Systems Applications*, Bridge printery Pty. Ltd., 1992. (required) (comment: available through UNSW (<http://www.pv.unsw.edu.au/buybook.html>))

Topical Outline:

Solar Cells & Sunlight

- The photovoltaic vision

- Physical source of sunlight, solar constant & insolation data

- Direct & diffuse radiation

Review of Semiconductor Properties

- Dynamics of electrons and holes

- Generation & Recombination processes semiconductors

- Interaction of sunlight with semiconductors

- Reflectance & absorption of light

Junction and Operating Principles of Solar Cells

- Homo & hetero-junctions

- Dark & illuminated characteristics of solar cells

- Internal quantum efficiency of solar cell

- Equivalent circuit of solar cells

- Solar cell output parameters

Efficiency Limits & Losses in Solar Cells

- Efficiency limits for black-body cells

- Short-circuit current losses

- Open-circuit voltage losses

- Fill factor losses

- Effect of temperature on cell performance

- Practically achievable efficiency limit

Silicon Solar Cell & Module Fabrication

- Promising photovoltaic silicon materials

- Baseline silicon solar cell fabrication

- Processing of advanced silicon solar cells

- Photovoltaic module construction

Design of High Efficiency silicon Solar Cells

- Surface recombination velocity & spectral response considerations

- heavy doping effects, junction depth, & emitter dopant profile considerations

- Substrate doping, thickness & diffusion length considerations

- Grid design

- Back surface field design

- Antireflection coating design

- Textured surfaces for light trapping

Heterojunction, Thin-Film & Other Promising Solar Cells

- Gallium arsenide solar cells

- Amorphous silicon thin-film solar cells

- Polycrystalline thin-film CdTe and CuInSe₂ cells

- Multijunction solar cells

- Concentrator cells

Photovoltaic Systems & Applications

- Stand alone PV Systems

- Utility-interactive PV systems

- Modeling & design of PV systems

- PV in buildings

- cost analysis & future of PV systems