OSE 5414

Fundamentals of Optoelectronic Devices

College of Optics and Photonics, University of Central Florida

COURSE SYLLABUS

Instructor:	Pieter G. Kik	Term:	Fall 2021
Office:	CREOL A220	Class Meeting Days:	T/R
Phone:	407-823-4622	Class Meeting Hours:	9 AM-10:15 AM
E-Mail:	kik@creol.ucf.edu	Class Location:	A214 / Zoom
Website:	https://webcourses.ucf.edu	Office Hours:	T/R 4:30-5:30

I. University Course Catalog Description

Fundamentals of Optoelectronic Devices: Operation, methods of fabrication, applications, and limitations of various optoelectronic devices including quantum well semiconductor devices.

II. Course Overview

This course aims at covering the physics and engineering issues that define the basic semiconductor optoelectronics devices. We start off with learning about the material properties of bulk crystals and define the concept of an energy band for the electrons and holes in semiconductors using fundamental quantum mechanics; then we relate the energy of the free electrons to the materials' electrical and optical properties. The behavior of p-n junctions and other barrier potentials in semiconductor structures are analyzed. These junctions are presented as simple instruments that enable electrical injection of electrons with excess potential energy for radiative emission of photons. In reverse, these same junctions cause photo-generated electrons to drift rapidly across the field to generate a photocurrent. Semiconductor optoelectronic devices such as the LED, the laser diode, the photodetector are presented as mere converters of electrical energy to photon energy and vice-versa. The course contains a good mix of the electrical properties and optical properties of semiconductors and the interplay between photons and the free electrons within.

III. Course Objectives and Outcomes

The students will have a basic understanding of solid state physics as applied to semiconductor optical devices. There will be detailed discussions about the characteristics, operation, and limitation of these devices. The students will be able to use the knowledge gained in this course to further their research and also to take more advanced classes in thin film optoelectronics and semiconductor lasers.

IV. Course Prerequisites

Graduate Standing or C.I.

V. Course Credits

3 (3,0)

VI. Suggested Texts and Materials

Main text: Semiconductor Physics and Devices: Basic Principles 4th edition - Donald A. Neamen
Physics of Semiconductor Devices - S. Sze
Fundamentals of Photonics - B. Saleh
Semiconductor Optoelectronic Devices - Pallab Bhattacharya
Optoelectronics - E. Rosencher & B. Vinter
Semiconductors - R. A. Smith, Cambridge

VII. Topics Covered

- Crystal Structure of Solids
- Introduction to Quantum Mechanics
- Introduction to the Quantum Theory of Solids
- The Semiconductor in Equilibrium
- Carrier Transport Phenomena
- Nonequilibrium Excess Carriers in Semiconductors
- The PN Junction
- The PN Junction Diode
- Metal-Semiconductor and Semiconductor Heterojunctions
- Optical Devices
    - Optical Absorption
    - Solar Cells
    - Photodetectors
    - Photoluminescence and Electroluminescence
    - Light Emitting Diodes
    - Laser Diodes

VIII. Zoom sessions

This course will be taught face-to-face and live-streamed over Zoom. Zoom meeting information will available on the course website on Webcourses@UCF. Lectures will be synchronous ("real time"), and class meeting recordings will be available to students registered for this class only if there are valid reasons for not attending the synchronous session.

Students are expected to follow appropriate university policies and maintain the security of passwords used to access class meetings and recorded lectures. Please take the time to familiarize yourself with Zoom by visiting the UCF Zoom Guides at https://cdl.ucf.edu/support/webcourses/zoom. You may choose to use Zoom on your mobile device (phone or tablet).

IX. Basis for Final Grade

Assessment	Percent of Final Grade
Homework	20%
Midterm	30%
Final	50%
	100%