



CREOL  
The College of Optics and Photonics  
University of Central Florida

## OSE 4410: Optoelectronics

### COURSE SYLLABUS

Instructor: Dr. Patrick LiKamWa  
Office: CREOL 209  
Phone: 407-823-3816  
E-Mail: patrick@creol.ucf.edu  
Office Hours: by appointment either in person in rm-209 or via ZOOM

Term: Spring 2022  
Class Meeting Days: Tuesdays and Thursdays  
Class Meeting Time: 9:00 AM - 10:15 AM  
Class Location: CREOL 102

#### I. University Course Catalog Description

Introduction to the principles and design of semiconductor optoelectronic devices including photodiodes, solar cells, light-emitting diodes, laser diodes, and CCDs. Applications include photovoltaics, displays, photodetection, and optical communications.

#### II. Course Overview

This course is an introduction to the principles, design, and applications of optoelectronic devices. The course begins with a description of the interaction of light with semiconductor materials in a p-n junction configuration. This includes the phenomena of absorption, electroluminescence, and stimulated emission. The distinction between direct and indirect compound semiconductor materials is noted. Basic devices are then described: photodiodes, light emitting diodes (LEDs), semiconductor optical amplifiers, and laser diodes are then described. Array detectors, including complementary metal-oxide-semiconductor (CMOS) and charge-coupled devices (CCD) arrays, and array LEDs are then introduced. Basic specifications and applications of each of these devices are described, including solar cells, imaging with array detectors, and LED displays.

#### III. Course Learning Objectives

Upon completion of this course, students should be able to apply the fundamentals of semiconductors solid state physics in understanding the operation of optoelectronic devices  
The student will be able to understand:  
the relationship between the electron and the photon  
the importance of energy barriers in semiconductors at p-n junctions for electron to photon conversions.  
the core principles underlying the operation of basic optoelectronic devices such as the LEDs, Laser Diodes and Photo Detectors.

#### IV. Course Prerequisites

EEE 3307C Electronics I, OSE 3052 Introduction to Photonics.

#### V. Credits

3

#### VI. Course Textbook

Optoelectronics and Photonics: Principles and Practices, Second Edition S.O.Kasap

#### Reference (Optional) Books

Solid State Electronic Devices (6th Edition), Ben Streetman, Sanjay Banerjee

Optoelectronic Devices, Niloy K Dutta, Xiang Zhang, World Scientific Publishing Company, 2018.  
Physics of Semiconductor Devices, Simon M. Sze, Kwok K. Ng, Wiley, 2006

## VII. Course Requirements

- The student is expected to review the textbook, notes, and other materials before class.
- You are required to attend class either in person or via ZOOM.

## VIII. Course Grading

Grading Scale (%)	Rubric Description
$100 \geq A > 93 \geq A^- > 90$	Excellent, has a strong understanding of all concepts and is able to apply the concepts in all and novel situations. Has full mastery of the content of the course.
$90 \geq B^+ > 87 \geq B > 83 \geq B^-$	Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations.
$80 \geq C^+ > 77 \geq C > 73 \geq C^-$	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
$70 \geq D^+ > 67 \geq D > 63 \geq D^-$	Below average, has a basic understanding of only the simple concepts and is able to apply to only a limited number of the most basic situations.
$60 \geq F$	Demonstrates little to no understanding of the course content.

Course Item	Percent of Final Grade
Homework	10%
Quizzes	20%
Two mid-term tests (20% each)	40%
Final Exam	30%
	100%

## IX. Grading Objections

All objections to grades should be made IN WRITING WITHIN ONE WEEK of the work in question. Objections made after this period has elapsed will NOT be considered – NO EXCEPTIONS.

## X. Professionalism and Ethics

Academic dishonesty in any form will not be tolerated. If you are uncertain as to what constitutes academic dishonesty, please consult The Golden Rule, the University of Central Florida's Student Handbook (<http://www.goldenrule.sdes.ucf.edu/>) for further details. As in all University courses, The Golden Rule Rules of Conduct will be applied. Violations of these rules will result in a record of the infraction being placed in your file and the student receiving a zero on the work in question AT A MINIMUM. At the instructor's discretion, you may also receive a failing grade for the course. Confirmation of such incidents can also result in expulsion from the University.

## XI. Students with Special Testing/Learning Needs

Students with special needs and require special accommodations must be registered with UCF Student Disability Services prior to receiving those accommodations. Students must have documented disabilities requiring the special accommodations and must meet with the instructor to discuss the special needs as early as possible in the first week of classes. UCF Student Disability Services can be contacted at <http://www.sds.sdes.ucf.edu/>, or at (407) 823-2371.

**XII. Excusal from Course Assignments and Course Examinations**

If an emergency arises and a student cannot submit assigned work on or before the scheduled due date or cannot take an exam on the scheduled date, the student **MUST** give notification to the instructor **NO LESS THAN 24 HOURS BEFORE** the scheduled date and **NO MORE THAN 48 HOURS AFTER** the scheduled date.

**XIII. Class Attendance and Participation**

- Regular class attendance is expected either in person.
- Come to class prepared.

**XIV. Quizzes and Exams**

- All quizzes will be conducted online. “LockDown Browser” will be used for proctoring
- All tests and exams will be in person in our assigned classroom.

**XV. Covid-19 Considerations**

- Please review all the announcements on the Syllabus page of our Webcourses.  
<https://webcourses.ucf.edu/>

*Note: The instructor reserves the right to modify the information contained in this document at his discretion.*



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## **OSE 4410: Optoelectronics**

### **COURSE SCHEDULE**

1	Introduction and Course Overview		Introduction and Course Memo
2	Physics of Semiconductors	Ch-3	Review of Semiconductor Concepts and Energy Bands Direct and Indirect Bandgap Semiconductors: E-k Diagrams pn Junction Principles Recombination Lifetime pn Junction Band Diagram Heterojunctions
3	LED	Ch-3	Light-Emitting Diodes: Principles Output Spectrum Quantum Well High Intensity LEDs LED Materials and Structures LED Efficiencies and Luminous Flux Basic LED Characteristics LEDs for Optical Fiber Communications Phosphors and White LEDs LED Electronics
4	Laser	Ch-4	Laser Oscillations: Threshold Gain Coefficient and Gain Bandwidth Broadening of the Optical Gain Curve and Linewidth Principle of the Laser Diode Elementary Laser Diode Characteristics Steady State Semiconductor Rate Equations Single Frequency Semiconductor Lasers Vertical Cavity Surface Emitting Lasers Semiconductor Optical Amplifiers
5	Photodetector	Ch-5	Principle of the pn Junction Photodiode The pin Photodiode Avalanche Photodiode Heterojunction Photodiodes Schottky Junction Photodetector Photoconductive Detectors and Photoconductive Gain Photovoltaic Devices: Solar Cells
6	Image Sensors	Ch-5	Active Matrix Array and CMOS Image Sensors 417 Charge-Coupled Devices

*Note: The dates of the topics will be posted on Webcourses and are subject to change depending upon how things progress during the course of the semester*



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### **University-Wide Face Covering Policy for Common Spaces and Face-to-Face Classes**

To protect members of our community, everyone is advised to wear a facial covering inside all common spaces including classrooms

### **Notifications in Case of Changes to Course Modality**

Depending on the course of the pandemic during the semester, the university may make changes to the way classes are offered. If that happens, please look for announcements or messages in [Webcourses@UCF](mailto:Webcourses@UCF) or Knights email about changes specific to this course.

### **COVID-19 and Illness Notification**

Students who believe they may have a COVID-19 diagnosis should contact UCF Student Health Services (407-823-2509) so proper contact tracing procedures can take place.

Students should not come to campus if they are ill, are experiencing any symptoms of COVID-19, have tested positive for COVID, or if anyone living in their residence has tested positive or is sick with COVID-19 symptoms.

Students should contact their instructor as soon as possible if they miss class for any illness reason to discuss reasonable adjustments that might need to be made. When possible, students should contact their instructor(s) before missing class.

### **In Case of Faculty Illness**

If the instructor falls ill during the semester, there may be changes to this course, including having a backup instructor take over the course. Please look for announcements or mail in [Webcourses@UCF](mailto:Webcourses@UCF) or Knights email for any alterations to this course.

### **Course Accessibility and Disability COVID-19 Supplemental Statement**

Accommodations may need to be added or adjusted should this course shift from an on-campus to a remote format. Students with disabilities should speak with their instructor and should contact [sas@ucf.edu](mailto:sas@ucf.edu) to discuss specific accommodations for this or other courses.