



CREOL
The College of Optics and Photonics
University of Central Florida

OSE 4410: Optoelectronics

COURSE SYLLABUS

Instructor: Dr. Patrick LiKamWa
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Office Hours: by appointment via ZOOM

Term: Spring 2021
Class Meeting Days: Tuesdays and Thursdays
Class Meeting Time: 3:00 PM - 4:15 PM
Class Location: CREOL 102 and ZOOM

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 or via ZOOM.
- Come to class prepared.

XIV. Quizzes and Exams

- All quizzes and tests will be conducted online.
- “LockDown Browser” will be used for proctoring

XV. Covid-19 Considerations

- Please review all the announcements on the Syllabus page of our Webcourses.
<https://webcourses.ucf.edu/courses/1357750/assignments/syllabus>.

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



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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 required to wear a facial covering inside all common spaces including classrooms

(<https://policies.ucf.edu/documents/PolicyEmergencyCOVIDReturnPolicy.pdf>). Students who choose not to wear facial coverings will be asked to leave the classroom by the instructor. If they refuse to leave the classroom or put on a facial covering, they may be considered disruptive (please see the [Golden Rule](#) for student behavior expectations). Faculty have the right to cancel class if the safety and well-being of class members are in jeopardy. Students will be responsible for the material that would have been covered in class as provided by the instructor.

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 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. CDC guidance for COVID-19 symptoms is located here:

(<https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>)

Students should contact their instructor(s) 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 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 to discuss specific accommodations for this or other courses.

Statement for Courses with a Face-to-Face Component

Should this course shift to remote-only instruction, the university has provided several resources to assist students with learning: <https://digitallearning.ucf.edu/newsroom/keeplearning/>

Live and Recorded Lectures (optional if applicable): This course will include synchronous (“real time”) sessions that will also be available as a recorded session for later review in Webcourses@UCF. Students who are unable to attend on-campus sessions, are expected to review these available sessions. Students who are unable to actively participate in on-campus or remote learning, should contact their instructor to explore options. Any synchronous meeting times will be announced via Webcourses@UCF and should appear on the Webcourses@UCF calendar should remote instruction be activated.

Such recordings/streaming will only be available to students registered for this class. These recordings are the intellectual property of the faculty and they may not be shared or reproduced without the explicit, written consent of the faculty member. Further, students may not share these sessions with those not in the class or upload them to any other online environment. Doing so would be a breach of the Code of Student Conduct, and, in some cases, a violation of the Federal Education Rights and Privacy Act (FERPA).

Technology Access – Depending upon modality, this course might need to shift to remote or fully online instruction based on medical guidance. This course also could be fully online and thus this could require access to additional technology. If students do not have proper access to technology, including a computer and reliable Wi-Fi, please let the instructor know as soon as possible. Information about technology lending can be found at <https://it.ucf.edu/techcommons/> and <https://library.ucf.edu/libtech>.