



UNIVERSITY OF
CENTRAL FLORIDA

OSE 5312 - Light Matter Interaction

Section: 0001

Optics and Photonics

Course Information

Term: Spring 2025

Class Meeting Days: TR

Class Meeting Time: 10:30AM - 11:45AM

Class Meeting Location: CROL 0102

Modality: P

Credit Hours: 3.00

Combined Section Information

This syllabus applies to sections OSE 5312 0001, OSE 5312 0V02.

Instructor Information

Romain Gaume

Title: Prof.

Office Location: A339

Office Hours:

Tuesday 12-1pm

Email: gaume@ucf.edu

Course Description

OSE 5312 OPT-OPT 3(3,0)Light Matter Interaction: PR: Graduate standing or C.I.
Microscopic theory of absorption, dispersion, and refraction of materials; classical and quantum mechanical description of optical properties. Fall, Spring.

This course discusses the interaction of light with matter. We will find that many important optical properties can be described quite accurately using surprisingly simple models. Initially, we will model atoms as classical dipole oscillators (“electrons on springs”). We will use the calculated behavior of these model atoms together with Maxwell’s equations to obtain expressions for the frequency dependent refractive index, absorption, and susceptibility. Using this theory, we will be able to understand the optical properties of gases, liquids and solids, including metals, semiconductors and dielectrics. To improve on our model descriptions, we will discuss the foundations of quantum mechanics and derive a quantum mechanical description of the refractive index. We will include the interaction of light with oscillations of atoms (molecular vibrations and rotations, phonons) and consider how quantum mechanics affects molecular absorption and emission spectra.

Student Learning Outcomes

After successful completion of this course, students will be able to identify materials based on reflection, transmission, absorption spectra, predict optical properties based on dopant concentrations and resonances, predict refractive index spectra based on absorption spectra, and understand the role of quantum mechanics in optical properties.

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Course Materials and Resources

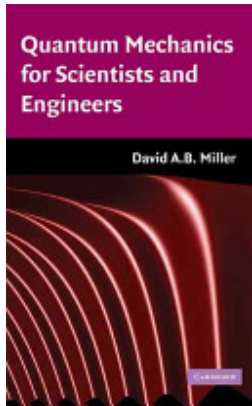
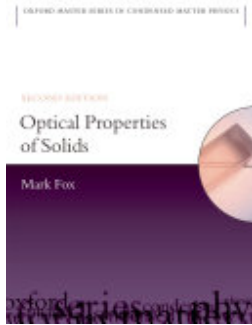
Optical Properties of Solids

ISBN: 9780191576720

Authors: Mark Fox

Publisher: Oxford University Press

Publication Date: 2010-03-26



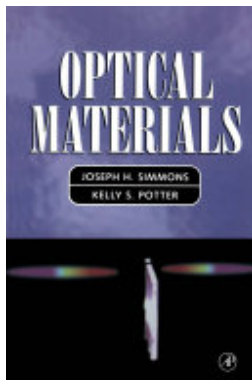
Quantum Mechanics for Scientists and Engineers

ISBN: 9780521897839

Authors: D. A. B. Miller

Publisher: Cambridge

Publication Date: 2008-04-21



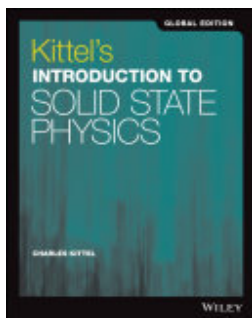
Optical Materials

ISBN: 9780126441406

Authors: Joseph H. Simmons, Kelly S. Potter

Publisher: Academic Press

Publication Date: 2000-01-01



Introduction to Solid State Physics

ISBN: 9781119454168

Authors: Charles Kittel, Paul McEuen

Publisher: John Wiley & Sons

Publication Date: 2018-01-01

Course Assessment and Grading Procedure

The semester's grade will be obtained from the following assessments and weights:

Assignments	Grade Weighting
Homework (6)	60%
Midterm Exam (1)	20%
Final Exam (1)	20%
Total	100%

Grading Scale

Letter Grade	Percentage
A	94-100%
A-	90-93%
B+	87-89%
B	84-86%
B-	80-83%
C+	77-79%
C	74-76%
C-	70-73%
D+	67-69%
D	64-66%
D-	61-63%
F	0-60%

Policies for Course Grade

Makeup Work Policy

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 24 hours after** the scheduled date. Makeup exams will only be offered with prior permission from instructor.

Missed/Late Assignments

Homework posted in late will be assessed a penalty: a half-letter grade if it is one day late, or a full-letter grade for 2-7 days late. Homework will not be accepted if overdue by more than seven days or after solutions are posted.

Attendance

Attendance is not graded, but it is strongly encouraged to help you stay current with class announcements, engage in discussions, and improve your chances of success.

Course Accessibility

The University of Central Florida is committed to providing access and inclusion for all persons with disabilities. Students with disabilities who need access to course content due to course design limitations should contact the professor as soon as possible. Students should also connect with [Student Accessibility Services \(SAS\)](#) (Ferrell Commons 185, sas@ucf.edu, phone 407-823-2371). For students connected with SAS, a Course Accessibility Letter may be created and sent to professors, which informs faculty of potential course access and accommodations that might be necessary and reasonable. Determining reasonable access and accommodations requires consideration of the course design, course learning objectives and the individual academic and course barriers experienced by the student. Further conversation with SAS, faculty and the student may be warranted to ensure an accessible course experience.

Academic Integrity

Students should familiarize themselves with UCF's Code of Conduct at [Student Conduct and Integrity Office](#). According to Section 1, "Academic Misconduct," students are prohibited from engaging in:

- a. Academic misconduct is defined as any submitted work or behavior that obstructs the instructor of record's ability to accurately assess the student's understanding or completion of the course materials or degree requirements (e.g., assignment, quiz, and/or exam). Examples of academic misconduct include but are not limited to: plagiarism, unauthorized assistance to complete an academic exercise;

unauthorized communication with others during an examination, course assignment, or project; falsifying or misrepresenting academic work; providing misleading information to create a personal advantage to complete course/degree requirements; or multiple submission(s) of academic work without permission of the instructor of record.

- b. Any student who knowingly helps another violate academic behavior standards is also in violation of the standards.
- c. Commercial Use of Academic Material. Selling of course material to another person and/or uploading course material to a third-party vendor without authorization or without the express written permission of the University and the instructor of record. Course materials include but are not limited to class notes, the instructor of record's slide deck, tests, quizzes, labs, instruction sheets, homework, study guides, and handouts.
- d. Soliciting assistance with academic coursework and/or degree requirements. The solicitation of assistance with an assignment, lab, quiz, test, paper, etc., without authorization of the instructor of record or designee is prohibited. This includes but is not limited to asking for answers to a quiz, trading answers, or offering to pay another to complete an assignment. It is considered Academic Misconduct to solicit assistance with academic coursework and/or degree requirements, even if the solicitation did not yield actual assistance (for example, if there was no response to the solicitation).

Responses to Academic Dishonesty, Plagiarism, or Cheating

Students should also familiarize themselves with the procedures for academic misconduct in UCF's student handbook, [The Golden Rule](#). UCF faculty members have a responsibility for students' education and the value of a UCF degree, and so seek to prevent unethical behavior and respond to academic misconduct when necessary. Penalties for violating rules, policies, and instructions within this course can range from a zero on the exercise to an "F" letter grade in the course. In addition, an Academic Misconduct report could be filed with the Office of Student Conduct and Academic Integrity, which could lead to disciplinary warning, disciplinary probation, or deferred suspension or separation from the University through suspension, dismissal, or expulsion with the addition of a "Z" designation on one's transcript.

Being found in violation of academic conduct standards could result in a student having to disclose such behavior on a graduate school application, being removed from a leadership position within a student organization, the recipient of scholarships, participation in University activities such as study abroad, internships, etc.

Let's avoid all of this by demonstrating values of honesty, trust, and integrity. No grade is worth compromising your integrity and moving your moral compass. Stay true to doing the right thing: take the zero, not a shortcut.

Title IX

Title IX prohibits sex discrimination, including sexual misconduct, sexual violence, sexual harassment, and retaliation. If you or someone you know has been harassed or assaulted, you can find resources available to support the victim, including confidential resources and information concerning reporting options at [Let's Be Clear](#) and [UCF Cares](#).

For more information on diversity and inclusion, Title IX, accessibility, or UCF's complaint processes contact:

- Title IX – OIE – [Office of Institutional Equity](#) & askanadvocate@ucf.edu
- Disability Accommodation – Student Accessibility Services – [Student Accessibility Services](#) & sas@ucf.edu
- [Access and Community Engagement](#) (including the Ginsberg Center for Inclusion and Community Engagement, Military and Veteran Student Success, and HSI Initiatives)
- UCF Compliance and Ethics Office – [Compliance, Ethics, and Risk Office](#) & complianceandethics@ucf.edu
- The [Ombuds Office](#) is a safe place to discuss concerns.

Reporting an Incident or Issue

If you believe you have experienced abusive or discriminatory behavior by any faculty or staff member, contact the Office of Institutional Equity [online](#) or at 407-823-1336. You can also choose to report using the UCF Integrity Line and can report anonymously or as

yourself at 1-855-877-6049 or using the [online form](#). UCF cares about you and takes every report seriously. For more information see the [Reporting an Incident or Issue Webpage](#).

Deployed Active-Duty Military Students

Students who are deployed active duty military and/or National Guard personnel and require accommodation should contact their instructors as soon as possible after the semester begins and/or after they receive notification of deployment to make related arrangements.

Campus Safety

At UCF Public Safety and Police, safety is the top priority. Emergencies on campus are rare, but if one should arise, it's important to be familiar with some basic safety and security concepts.

- In an emergency, always dial 911.
- Every UCF classroom has an **Emergency Procedure Guide** posted on a wall near the door, which will show you how to respond to a variety of situations. This guide can also be found online [here](#).
- In the event of an active threat, remember **AVOID, DENY, DEFEND**. Choose the best course of action and act immediately. Watch the video [here](#) to learn more.
 - **AVOID**. Pay attention to your surroundings and have an exit plan. Get as much distance and as many barriers between you and the threat as quickly as possible.
 - **DENY**. When avoiding is difficult or impossible, deny the threat access to you and your space. Lockdown by creating barriers, turning the lights off and remaining quiet and out of sight. Make sure your cell phone is silenced, but do not turn it off.
 - **DEFEND**. When you are unable to put distance between yourself and the threat, be prepared to protect yourself. Commit to your actions, be aggressive and do not fight fairly. Do whatever it takes to survive.

- For emergencies on campus, UCF will utilize the [UCF Alert](#) system. All UCF students, faculty and staff are automatically enrolled to receive these email and text alerts, however, it's a good idea to frequently ensure your [contact information is up to date](#).

Financial Aid Accountability

All instructors/faculty are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please complete this activity by the end of the first week of classes or as soon as possible after adding the course. Failure to do so may result in a delay in the disbursement of your financial aid.

Class Schedule

Tentative schedule - check most recent lecture to see up-to-date info

Day	Date	Subjects covered	Description	Notes	Fox	Miller
T	1/7/2025	Introduction - broad overview of topics to be covered		1	1	
Th	1/9/2025	Review of Maxwell's equations	continuum	2	2	
T	1/14/2025	Wave propagation in dispersive media	continuum	3	2	
Th	1/16/2025	Kramers-Kronig relations	continuum	4	2	
T	1/21/2025	Dielectrics - the Lorentz model (part 1)	oscillator (classical)	5	2	
Th	1/23/2025	Dielectrics - the Lorentz model (part 2)	oscillator (classical)	5	2	
T	1/28/2025	Metals and doped semiconductors - Drude model (part 1)	oscillator (classical)	8	7	
Th	1/30/2025	Metals and doped semiconductors - Drude model (part 2)	oscillator (classical)	8	7	
T	2/4/2025	More on Lorentz model: anharmonic oscillator and NLO (part 1)	oscillator (classical)	15	11	
Th	2/6/2025	More on Lorentz model: anharmonic oscillator and NLO (part 2)	oscillator (classical)	15	11	
T	2/11/2025	Optical activity	oscillator (classical)	15	11	
Th	2/13/2025	Magneto-optic effects				
T	2/18/2025	Blackbody radiation (part 1)				
Th	2/20/2025	Blackbody radiation (part 2)				
T	2/25/2025	Midterm Exam 10:30-11:45am Room 102				
Th	2/27/2025	Quantum mechanics: Intro to Schrödinger eq., states of an infinite well	quantum	-		2
T	3/4/2025	States of a finite well	quantum	-		2
Th	3/6/2025	Time dependence, expectation values, orthonormal complete sets	quantum	-		3
T	3/11/2025	From time dependent amplitudes to susceptibility and absorption	quantum	-	B	7
Th	3/13/2025	Molecular vibrations, quantum rotor, vibration - rotation spectra	oscillator (Q & class)	10,7		
T	3/18/2025	No Class (Spring Break)				
Th	3/20/2025	No Class (Spring Break)				
T	3/25/2025	Classical and quantum description of vibrations in molecules (part 1)	oscillator (classical)	6,10		
Th	3/27/2025	Classical and quantum description of vibrations in molecules (part 2)	oscillator (classical)	6,10		
T	4/1/2025	Vibrations in solids: phonon dispersion in linear chains of atoms	oscillator (classical)	10	10	
Th	4/3/2025	Vibrations in solids: reciprocal space, phonon dispersion in real materials (part 1)		10	10	
T	4/8/2025	Vibrations in solids: reciprocal space, phonon dispersion in real materials (part 2)		10	10	
Th	4/10/2025	Optical properties of semiconductors: Kronig-Penney Model and bandgaps	QM & band structure	11	3, C	8
T	4/15/2025	Optical properties of semiconductors: electronic band structure	QM & band structure	11	3, C	8
Th	4/17/2025	Optical properties of semiconductors: interband transitions	QM & band structure	11	3, C	8
T	4/22/2025	No Class				
Th	4/24/2025	No Class				
T	4/29/2025	FINAL EXAM: 10:00am-12:50 am Room 102				