



UNIVERSITY OF
CENTRAL FLORIDA

OSE 6111 - OPTICAL WAVE PROPAGATION

Section: 0001

Optics and Photonics

Course Information

Term: Fall 2024

Class Meeting Days: MW

Class Meeting Time: 10:30 - 11:45

Class Meeting Location: CROL 0102

Modality: P

Credit Hours: 3.00

Instructor Information

Miguel Bandres

Title: Assistant Professor

Office Location: A222

Office Hours:

Office hours are planned for Wednesday 2:00pm-4:00pm, but I will be happy to discuss the material with you at any time. Please send me a webcourses/CANVAS Inbox if you would like to schedule a meeting.

Email: bandres@creol.ucf.edu

Teaching Assistants

David Guacaneme

Course Description

OSE 6111 OPT-OPT 3(3,0)Optical Wave Propagation: PR: Graduate standing or C.I.
Optical propagation of light waves as applied to isotropic, anisotropic, and inhomogeneous media, guided waves and Gaussian beams. Fall, Spring.

This course discusses the fundamental properties of light propagation in free space and inside various technologically relevant materials, as well as the effect of materials interfaces on light propagation. The covered propagation modes include plane waves, Gaussian beams, and Floquet modes. Isotropic, anisotropic (uniaxial, biaxial), and periodic (1D, 2D) media are covered.

Student Learning Outcomes

After successful completion of this course, students will be able to understand and use:

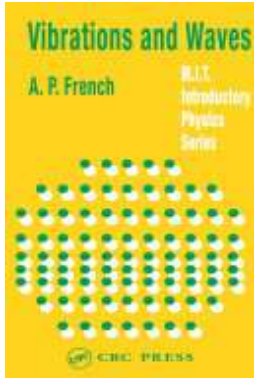
- Properties of oscillatory systems and the wave equation
- The Fourier Transform
- Fundamental properties of light propagation
- Reflection and refraction of waves
- Maxwell's equations and their boundary conditions
- Propagating waves, including plane waves and Gaussian beams
- Propagation in different media, such as isotropic, anisotropic, and periodic
- Metallic and dielectric waveguides and the fundamental principles of waveguiding

Course Materials and Resources

No textbook requires. Notes and references will be provided for relevant topic.

Recommended Course Materials

Title: Vibrations and Waves

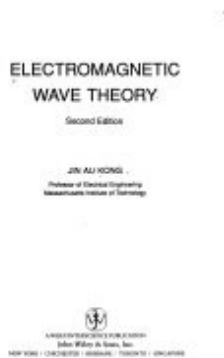


ISBN: 9781482289350
Authors: A.P. French
Publisher: CRC Press
Publication Date: 2017-12-21

Title: Waves (Draft)

Authors: David Morin

Online Access: <https://davidmorin.physics.fas.harvard.edu/books/waves/>

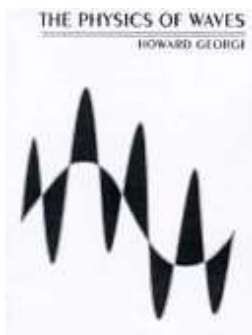


Title: Electromagnetic Wave Theory

Authors: Jin Au Kong

Publisher: Wiley-Interscience

Publication Date: 1990-01-01



Title: The Physics of Waves

Authors: Howard Georgi

Publisher: Addison Wesley Publishing Company

Publication Date: 1993-01-01

Course Assessment and Grading Procedure

Assessment	Percent of Final Grade
Homework (~9 assignments)	50%

Midterm I	15%
Midterm II	15%
Final	20%
	100%

Homework will be submitted online through [webcourses/CANVAS](#).

Homework is due one week after it is assigned.

Homework policy: The following guidelines are intended to ensure everyone is clear and comfortable regarding what is expected of them for coursework in this class. You can talk to anyone you wish, and read anything you wish (but not previous homework solutions). I encourage you to discuss the course material and the homework problems with your classmates. However, before you discuss a homework problem with a classmate or look for related information in some other reference, you must first make a solid effort to solve it on your own. After you discuss a homework problem with a classmate or read related information in some other reference, I expect you **to write up the solution on your own, starting from something close to a blank sheet of paper and relevant references like class notes and books.**

Fell free to email me (by [webcourses/CANVAS Inbox](#)) regarding any question or concern about the class or to request a meeting.

Grading Scale

Letter Grade	Percentage (%)
A	95-100
A-	90-94
B+	85-89
B	80-84
B-	70-79
C+	65-69
C	55-64
D	50-55
F	<=49

Policies for Course Grade

Missed/Late Assignments

Homework turned in late will be assessed a penalty: 7% will be deducted for each day late and will not be accepted if overdue by more than 3 days **or** if submitted after the solution is posted (which may occur at any time after the due date)

Attendance

Regular class attendance (unless you are registered for the online modality) is required in this course and is necessary for students to understand many of the topics covered. Students must be on time to class. If a class is missed, it is the responsibility of the student to find out what materials were covered.

Grade Dissemination

Graded tests and materials in this course will be returned individually and not posted publicly. You can access your scores at any time using the webcourses/CANVAS . Please note that scores returned mid-semester are unofficial grades. If you need help accessing myUCF Grades, see the online tutorial: <https://myucfgrades.ucf.edu/help/>.

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.

Reporting an Incident or Issue

If you believe you have experienced abusive or discriminatory behavior by any faculty of 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](#).

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.

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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

Course Outline

Review of Vector Analysis

- Vector representation and vector coordinate transformations
- Vector operations
- Differential vector operations and Gauss' and Stokes' theorems

Fourier analysis in linear systems

- Fourier Transform
- Discrete Fourier Transform
- Fast Fourier Transform
- Applications of the Fourier Transform

Electromagnetic Field Theory

- Electromagnetic fields
- Dielectric, conducting, and magnetic materials
- Conduction and displacement currents
- Constitutive relationships and permittivity, permeability, and conductivity
- Lorentz force equation

Maxwell's Equations

- Integral and differential time varying Maxwell's equations
- Power and energy and the Poynting's theorem
- Complex time harmonic Maxwell's equations
- Boundary conditions and field matching at interfaces.

Electromagnetic Propagation in Linear Isotropic Homogenous Media

- The wave equation and Helmholtz equation
- Plane wave propagation
- Power flow density
- Electromagnetic field polarization: linear, circular, and elliptical

Reflection and Refraction at Planar Interfaces

- Field matching at planar interfaces
- Propagating, surface, and evanescent waves
- TE and TM polarizations
- Reflection and transmission coefficients,
- Brewster angle, critical angle, total internal reflection
- Reflection and refraction in multi-layered structures
- Quarter-wave stack and applications in thin film coatings

Electromagnetic Propagation in Anisotropic Media

- Dielectric tensor classification of anisotropic media
- Dispersion relation and light propagation in uniaxial and biaxial media
- Power flow in anisotropic media
- Refraction and reflection at anisotropic interface
- Jones's calculus and retardation plates
- Index ellipsoid

Metallic Waveguides

- Parallel plate metallic waveguides
- Dispersion relations for TEM, TE, and TM modes
- Cut-off conditions and single mode operation
- Field distribution and power flow in metallic waveguides

Dielectric Waveguides

- Dielectric planar asymmetric waveguides
- Dispersion relations for TE and TM modes
- Cut-off conditions and single mode waveguide
- Field distribution and power flow in planar waveguides
- Mode orthogonally and mode excitation

Optical Propagation in Periodic Media

- Periodic field spatial harmonics
- Generalized phased matching condition and the grating equation
- Planar, conical, and spherical diffraction
- Propagation and evanescent diffracted orders

Class Recording

Recordings may not be used as a substitute for class participation and class attendance, and **may not be published or shared without the written consent of the faculty member.** Failure to adhere to these requirements may constitute a violation of the University's Student Code of Conduct as described in the Golden Rule. To publish means to share, transmit, circulate, distribute or otherwise provide access to the recording, regardless of format or medium, to another person, or persons, including but not limited to another student in the class. Additionally, a recording, or transcript of the recording, is published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, picket signs, or any mode of print.