UNIVERSITY OF CENTRAL FLORIDA

OSE 6211 - Imaging and Optical Systems

Section: 0001

Optics and Photonics

Course Information

Term: Spring 2026
Class Meeting Days: MW
Class Meeting Time: 10:30AM - 11:45AM
Class Meeting Location: CROL 0102
Modality: P
Credit Hours: 3.00

Instructor Information

Name: Eric Johnson
Title: Professor
Office Location: CREOL 213
Office Hours
TBD
Email: Eric.Johnson2@ucf.edu

Course Description

OSE 6211 OPT-OPT 3(3,0)Imaging and Optical Systems: PR: Admitted to a graduate program in Optics, Physics or Electrical Engineering, or C.I. Linear

systems theory of discrete and continuous one- and two-dimensional systems. Applications to optical polarization, pulse propagation, and image formation. Fall,Spring.

Expanded Description

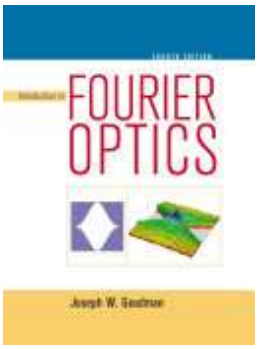
Graduate-level continuation of Fourier optics and wave propagation with a modal emphasis in Optical systems. The course begins by treating structured light and angular-spectrum representations as natural solutions of the paraxial wave equation, and uses this framework to develop coherent imaging theory, optical signal processing, diffractive and holographic optics, phase retrieval, Fourier ptychography, and computational imaging architectures. Emphasis is placed on system-operator models, synthetic apertures, inverse problems, and the role of coherence and speckle in imaging and sensing performance.

Student Learning Outcomes

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

• Interpret optical fields as superpositions of propagation modes of the paraxial wave equation.
• Analyze propagation and imaging systems using angular-spectrum and modal representations.
• Explain and model structured-light and diffraction-invariant beams for imaging and sensing.
• Analyze coherent and incoherent imaging systems using PSF/OTF/CTF concepts.
• Design and interpret optical signal-processing, diffractive, and holographic systems.
• Implement and evaluate phase-retrieval, digital holography, and ptychographic algorithms.
• Formulate computational imaging systems as inverse problems with noise and regularization.

Required Course Materials and Resources



Introduction to Fourier Optics
ISBN: 9781319153045
Authors: Joseph W. Goodman
Publisher: Macmillan Higher Education
Publication Date: 2017-10-30

Course Assessment and Grading Procedure

Course Grading:

Exam I: 30%

Exam II: 30%

Exam III: 30%

Semester Project: 10%

Optional Final Exam: 30% baseline weight (**may replace lowest exam score**)

Exams (30%, 30%, 30%)

All exams are closed book. Students may bring one 8.5 × 11 inch sheet of notes, handwritten or printed, with notes, equations, or constants on both sides for reference. No make-up exams will be permitted without the prior approval of the instructor, and only when arrangements are made before the scheduled exam date.

Optional Final Exam (30%)

The final exam will be closed book. Students may bring one 8.5 × 11 inch sheet of notes, handwritten or printed, with notes, equations, or constants on both sides for reference.

The final exam is optional and may be used to replace the lowest of the three in-class exam scores, provided the final exam score is higher. The replacement is automatic, may replace only one exam score, and cannot lower a student's overall grade. Eligibility requires that all three in-class exams be attempted.

No make-up exams will be permitted without the prior approval of the instructor, and only when arrangements are made before the scheduled exam date.

Semester Project (10%): Expectations and Deliverables

Students will complete an individual project focused on a topic in coherent or computational imaging. Projects may involve numerical simulation, algorithm development, analysis of experimental or simulated data, or a research-style investigation of a modern imaging technique.

Deliverables include:

Project Proposal (2%): A one-page proposal outlining the project objectives, technical approach, and key references.

Final Written Report (4%): A concise technical report (not to exceed 10 pages) describing the methodology, results, and conclusions.

Project Presentation (4%): A 5-minute oral presentation using two slides (format to be announced), summarizing the project motivation, approach, and outcomes.

Assignment Schedule

Due Date	Assignment Name	Assignment Type	Points
1/13/26	Assignment 0	Assignment	0
2/25/26	Exam I	Assignment	100

Grading Scale

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%

Letter Grade	Percentage
D+	67-69%
D	64-66%
D-	61-63%
F	0-60%

Policies for Course Grade

Makeup Work Policy

All makeup work must be coordinated with the instructor.

Missed/Late Assignments

No late assignments will be accepted unless coordinated with the instructor prior to the

submission date.

Attendance

Attendance is not required; however, students are responsible for material presented and

will not be provided after lecture has been completed.

Artificial Intelligence (AI) Use Policy

AI may be used to augment the learning process; however, homework assignments must

be completed by the student and if AI is used, then it should be clearly stated as such.

Disability Access & Accommodations

The University of Central Florida is committed to providing equal access to all students with disabilities (ADHD, learning disabilities, Autism, chronic medical conditions, physical disabilities, etc.). To receive consideration for reasonable disability-related course accommodations, disabled students must contact Student Accessibility Services (SAS) and complete the steps required for SAS to review accommodation requests. More information can be found on the UCF Student Accessibility Services website under the Start Here tab or by contacting SAS directly (Ferrell Commons 185; sas@ucf.edu; Phone - 407-823-2371).

Approved accommodations are shared with course instructors via the SAS Course Accessibility Letter. Implementing certain accommodations may require discussion about specific considerations of the course design, course learning objectives, and the individual academic and course challenges experienced by the student. While students with disabilities or chronic health needs are also encouraged to discuss any course concerns with professors in addition to contacting SAS, professors are not required to facilitate disability-related adjustments to the course unless the professor has received a Course Accessibility Letter from SAS that outlines approved accommodations.

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:

1. 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 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 assessment, 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.

2. Any student who knowingly helps another violate academic behavior standards is also in violation of the standards.
3. 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 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.
4. 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" designated 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 access and community engagement, Title IX, accessibility, or UCF's complaint processes contact:

- Title IX – ONAC – Office of Nondiscrimination & Accommodations Compliance & 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 discrimination by any faculty or staff member, contact the Office of Nondiscrimination & Accommodations Compliance via the ONAC website or at 407-823-1336. You can also choose to report using the UCF

Integrity Line either anonymously or as yourself at 1-855-877-6049 or by 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 arrangements.

Campus Safety

At UCF's 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 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 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

Topics (Goodman Chapters and Supplementary Material):

1. Introduction and Background
2. Two-Dimensional Signals and Systems
3. Foundations of Scalar Diffraction Theory
4. Fresnel and Fraunhofer Diffraction
5. Computational Diffraction and Propagation
6. Coherent Optical Systems
7. Frequency Analysis of Optical Imaging Systems
8. Point Spread Function and Transfer Function Engineering
9. Wavefront Modulation
10. Analog Optical Information Processing
11. Holography and Diffractive Optics
12. Computational Imaging and Inverse Problems
13. Coherence and Speckle in Imaging

Class Schedule:

Introduction, Signals, and Fourier Foundations

Mon 1/12:

Course overview
Optical fields as signals
Linear shift-invariant systems
2D convolution and correlation

Wed 1/14:

2D Fourier transforms
Spatial frequency interpretation
Operator viewpoint (propagation as filtering)

Paraxial Wave Equation & Angular Spectrum

Mon 1/19: Holiday — No Class

Wed 1/21:

Scalar wave equation → paraxial approximation
Plane-wave solutions and angular spectrum
Propagation as phase evolution in spatial frequency

Structured Light: Solutions of the Paraxial Wave Equation

Mon 1/26:

Gaussian beam as lowest-order paraxial solution
Rayleigh range and Gouy phase

Wed 1/28:

Hermite–Gaussian and Laguerre–Gaussian modes
Orbital angular momentum and optical vortices
Intro to Bessel and Airy beams

Scalar Diffraction Theory

Mon 2/2:

Huygens–Fresnel principle
Rayleigh–Sommerfeld diffraction

Wed 2/4:

Validity regimes
Connection to angular spectrum and modes

Fresnel & Fraunhofer Diffraction

Mon 2/9:

Fresnel diffraction and quadratic phase operators

Wed 2/11:

Fraunhofer diffraction
Fourier-transform limit

Computational Diffraction & Coherent Imaging

Mon 2/16:

Angular spectrum propagation
FFT-based numerical propagation

Wed 2/18:

Coherent optical systems
Amplitude and phase objects
PSF / CTF / OTF and NA as bandwidth

Mon 2/23: Exam I — Topics 1–7
Wed 2/25:
Transition to PSF engineering

PSF Engineering & Wavefront Modulation
Mon 3/2:
Aberrations
PSF / OTF engineering
Wed 3/4:
Wavefront modulation
Pupils, phase masks, SLM concepts

Optical Signal Processing
Mon 3/9:
4-f systems
Spatial filtering
Wed 3/11:
Optical correlators
VanderLugt and joint transform correlators

Spring Break — Mar 16–21 (No classes)

Holography & Diffractive Optics
Mon 3/23:
Holography fundamentals
Recording and replay physics
Wed 3/25:
CGH, DOEs, digital holography

Mon 3/30: Exam II — Topics 8–11

Wed 4/1:
Bridge to computational imaging

Computational Imaging & Inverse Problems
Mon 4/6:
Computational imaging forward models
Wed 4/8:
Inverse problems
Regularization and priors

Synthetic Apertures & Structured Illumination

Mon 4/13:

Fourier ptychography
Synthetic numerical aperture
Structured illumination
Coded imaging

Wed 4/15:

Speckle statistics and contrast
Impact of coherence on imaging and sensing

Mon 4/20: Review for Exam III

Wed 4/22: Exam III — Topics 12–13

Mon 4/27: Comprehensive course review