



CREOL, The College of Optics and Photonics

OSE3043 Analytical Methods in Optics

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Credit Hours: 3

Term: FALL 2022

Syllabus

Time:	Tuesdays, Thursdays 4:30 PM to 5:45 PM (August 22-December 11)
Location:	Online ZOOM
Prerequisites:	Calculus I, II, and III (MAC 2311C, MAC 2312, and MAC 2313)
Course Description:	Applications-oriented course on analytical concepts prevalent in optics and engineering integrating MATLAB as a computational support tool.
Instructor:	Dr. Miguel A. Bandres
Email/Contact Info:	bandres@creo.ucf.edu
Office Hours and Location:	Wed 3:00pm-4:00pm (or any other time by request) ZOOM
Course Modality:	V-LIVE
Class Webcourse	https://webcourses.ucf.edu/courses/1412587

Feel free to email me (by CANVAS) with any questions or concerns about the class or to request a meeting.

Course Overview

Analytical and Coding Methods of Optics will expose the students to common analytical concepts used extensively in optics, physics, and other engineering disciplines. With a focus on applications, this class is designed to teach the students these concepts through relevant optical and engineering examples. The homework will have a required MATLAB component so the students, throughout the entirety of this course, will gain an intuitive understanding of computer coding and MATLAB specifically. This analytical methods class will extensively cover linear algebra (matrix and vector manipulations, solutions of linear systems, eigenvalues and eigenvectors, geometric transformations), Fourier transform, and vector calculus.

Course Prerequisites

This class will require the students to have completed Calculus I, II, and III (MAC 2311C, MAC 2312, and MAC 2313).

Required Texts and Materials

No textbook is required. Notes, slides, or/and online videos will be provided for each topic.

Supplementary (Optional) Texts and Materials

Before each topic, I will list specific optional references for each topic.

Mathematical Methods for Optical Physics and Engineering by Gbur ([Available Online at UCF Library](#))
Mathematical Methods for Physicists, Arfken & Weber ([Available Online at UCF Library](#))
Advanced Linear Algebra for Engineers with Matlab by Dianat & Saber
Advanced Engineering Mathematics 10th edition by Erwin Kreyszig.

The Basis for Final Grade

Assessment	Percent of Final Grade
Homework (~10 assignments)	70%
Midterm (Take home)	10%
Final (Take home)	15%
Participation	5%
	100%

Homework will be submitted online. Homework is due one week after being assigned. The lowest graded homework will be dropped.

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 HW 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 at 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.

Midterm and Final Policy: These are special homework, you will have one week to work on them, but they must be turned in before the deadline. The policy for midterm/final is the same as homework, with the only exception that you cannot discuss it with any other person.

Participation: Students should participate by asking questions, contributing to discussions, and by answering questions in class.

Grading Scale (%)	
100 – 95	A
94 – 90	A –
89 – 85	B +
84 – 80	B
79 – 75	B–
74 – 70	C+
69 – 67	C
66-65	C-
64-50	D
<50	F

Assignment Submission:

All homework, midterm and final, should be turned in by CANVAS in **PDF** and/or MATLAB format.

Late Work Policy:

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 six days.

Extra Credit Policy:

The homework (one) with the lowest grade will not count for the final grade.

List of Topics

1. MATLAB**2. Linear Algebra**

- Linear vector spaces
 1. Independent vectors
 2. Basis vectors
 3. Inner product, Scalar (Dot) Product
 4. Orthogonal vectors
- Linear operators (Matrix Algebra)
 1. Matrix Operations (multiplication, trace)
 2. Determinant
 3. Diagonalization and Inverse
 4. Symmetric and Orthogonal operators
 5. Hermitian and Unitary operators
- Projector Operators
- Eigenvalues and Eigenvectors of a linear operator
- Matrices, powers of matrices, and functions of matrices
- Systems of linear equations.
- Introduction to Linear Optimization.

3. Fourier Theory

- Fourier series and convergence
- Discrete Fourier transform
- Fast Fourier Transform, advantages, and dangers
- Fourier transform and its inverse
- Dirac Delta Function
- Properties of the Fourier transform
- Sampling Theory

4. Vector Calculus

- Dot, Cross, Triple Products, and Differentiation of vectors
- Linear integrals, Green Theorem
- Solid angle calculation and integrating over a surface
- Divergence, Curl and Stokes' theorem

Makeup 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 48 hours after the** scheduled date.

Attendance Policy:

Class attendance (by Zoom) is required in this course and is necessary for students to understand many of the topics covered. Students must be on time for class. If the student misses a class, it is the student’s responsibility to find out the materials covered.

Important Dates to Remember

All the dates and assignments are tentative and can be changed at the discretion of the professor.

- Drop/Swap Deadline: Fri, August 26th, 2022
- Grade Forgiveness Deadline: Fri, December 2th, 2022
- Withdrawal Deadline: Fri, October 28th, 2022
- Thanksgiving: Wed, Nov 23th – Sat, Nov 26th

Calendar:

August (3) / September (9)		October (8)		November (8)		December (1)	
23	25	4	6	1	3		1
30	1	11	13	8	10		
6	8	18	20	15	17		
13	15	25	27	22	Thanksgiving		
20	22			29			
27	29						

Financial Aid and Attendance: As of Fall 2014, all faculty members are required to document students' academic activity at the beginning of each course. In order to document that you began this course, **please complete the following academic activity by the end of the first week of classes, or as soon as possible after adding the course, but no later than August 26.** Failure to do so will result in a delay in the disbursement of your financial aid.

Grading Scale (%)	Rubric Description
100 ≥ 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.
89 > B ≥ 80	Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations.
79 > C ≥ 70	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
69 > D ≥ 60	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.
59 > F ≥ 0	Demonstrates no understanding of the course content.

Grade Objections:

All objections to grades should be made **in writing (by email) within one week** of the work in question. Objections made after this period has elapsed will **not** be considered – NO EXCEPTIONS.

Religious Observances

Students are expected to notify their instructor in advance if they intend to miss class to observe a holy day of their religious faith. For a current schedule of major religious holidays, see the Faculty Center's main web page under "Calendars," and for additional information, contact the Office of Diversity Initiatives at 407-823-6479.

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.

Grade Dissemination

Graded homework, tests, and materials in this course will be returned individually by CANVAS and not posted publicly. You can access your scores at any time using the CANVAS webcourse page. 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/>. If you want to get a projection/estimate of your grade in the course at any time, please let me know.

Policy Statements

Academic Integrity

Students should familiarize themselves with UCF's Rules of Conduct at <https://scai.sdes.ucf.edu/student-rules-of-conduct/>. According to Section 1, "Academic Misconduct," students are prohibited from engaging in

1. Unauthorized assistance: Using or attempting to use unauthorized materials, information or study aids in any academic exercise unless specifically authorized by the instructor of record. The unauthorized possession of examination or course-related material also constitutes cheating.
2. Communication to another through written, visual, electronic, or oral means: The presentation of material which has not been studied or learned, but rather was obtained through someone else's efforts and used as part of an examination, course assignment, or project.
3. Commercial Use of Academic Material: Selling of course material to another person, student, and/or uploading course material to a third-party vendor without authorization or without the express written permission of the university and the instructor. Course materials include but are not limited to class notes, Instructor's PowerPoints, course syllabi, tests, quizzes, labs, instruction sheets, homework, study guides, handouts, etc.
4. Falsifying or misrepresenting the student's own academic work.
5. Plagiarism: Using or appropriating another's work without any indication of the source, thereby attempting to convey the impression that such work is the student's own.
6. Multiple Submissions: Submitting the same academic work for credit more than once without the express written permission of the instructor.
7. Helping another violate academic behavior standards.
8. Soliciting assistance with academic coursework and/or degree requirements.

Responses to Academic Dishonesty, Plagiarism, or Cheating

Students should familiarize themselves with the procedures for academic misconduct in UCF's student handbook, *The Golden Rule* <<https://goldenrule.sdes.ucf.edu/>>. 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, 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.

Unauthorized Use of Websites and Internet Resources

There are many websites claiming to offer study aids to students, but in using such websites, students could find themselves in violation of academic conduct guidelines. These websites include (but are not limited to) Quizlet, Course Hero, Chegg Study, and Clutch Prep. UCF does not endorse the use of these products in an unethical manner, which could lead to a violation of our University's Rules of Conduct.

They encourage students to upload course materials, such as test questions, individual assignments, and examples of graded material. Such materials are the intellectual property of instructors, the university, or publishers and may not be distributed without prior authorization. Students who engage in such activity could be found in violation of academic conduct standards and could face course and/or University penalties. Please let me know if you are uncertain about the use of a website so I can determine its legitimacy.

Unauthorized Distribution of Class Notes

Third parties may attempt to connect with you to sell your notes and other course information from this class. Distributing course materials to a third party without my authorization is a violation of our University's Rules of Conduct. Please be aware that such class materials that may have already been given to such third parties may contain errors, which could affect your performance or grade.

Recommendations for success in this course include coming to class on a routine basis, visiting me during my office hours, connecting with the Teaching Assistant (TA), and making use of the Student Academic Resource Center (SARC), the University Writing Center (UWC), the Math Lab, etc. If a third party should contact you regarding such an offer, I would appreciate your bringing this to my attention. We all play a part in creating a course climate of integrity.

In-Class Recording

Students may, without prior notice, record video or audio of a class lecture for a class in which the student is enrolled for their own personal educational use. A class lecture is defined as a formal or methodical oral

presentation as part of a university course intended to present information or teach enrolled students about a particular subject.

Recording class activities other than class lectures, including but not limited to lab sessions, student presentations (whether individually or part of a group), class discussion (except when incidental to and incorporated within a class lecture), clinical presentations such as patient history, academic exercises involving student participation, test or examination administrations, field trips, private conversations between students in the class or between a student and the faculty member, and invited guest speakers is prohibited.

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.

Course Accessibility Statement

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) <http://sas.sdes.ucf.edu/> (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.

Deployed Active Duty Military Students

If you are a deployed active duty military student and feel that you may need a special accommodation due to that unique status, please contact your instructor to discuss your circumstances.

Campus Safety Statement

Emergencies on campus are rare, but if one should arise during class, everyone needs to work together. Students should be aware of their surroundings and familiar with some basic safety and security concepts.

- In case of an emergency, dial 911 for assistance.
- Every UCF classroom contains an emergency procedure guide posted on a wall near the door. Students should make a note of the guide's physical location and review the online version at <https://centralflorida-prod.modolabs.net/student/safety/index>.
- Students should know the evacuation routes from each of their classrooms and have a plan for finding safety in case of an emergency.
- If there is a medical emergency during class, students may need to access a first-aid kit or AED (Automated External Defibrillator). To learn where those are located, see <https://ehs.ucf.edu/automated-external-defibrillator-aed-locations>.

- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to <https://my.ucf.edu> and logging in. Click on “Student Self Service” located on the left side of the screen in the toolbar, scroll down to the blue “Personal Information” heading on the Student Center screen, click on “UCF Alert”, fill out the information, including e-mail address, cell phone number, and cell phone provider, click “Apply” to save the changes, and then click “OK.”
- Students with special needs related to emergency situations should speak with their instructors outside of class.
- To learn about how to manage an active-shooter situation on campus or elsewhere, consider viewing this video <https://youtu.be/NIKYajEx4pk>.