



ECE 8330: Fourier Optics and Optical Signal Processing
Section 001
FALL 2020

MEETING TIME: (online – Zoom) T/Th. 2:00 pm- 3:15 pm

MEETING LOCATION: Hybrid/Zoom meeting

INSTRUCTOR(s): Dr. Eric G. Johnson, 215 Riggs Hall, Duke Innovation Building (AMRL),
ejohns8@clemson.edu, (864)710-7778

OFFICE HOURS AND PROCEDURES: T/Th. 3:15 – 4:30 pm

COURSE MODALITY: HYBRID/Online

COURSE DESCRIPTION:

The objective of this course is to introduce the student to the basics of Fourier Optics and Optical Signal Processing. The specific topics include: Multidimensional Fourier analysis, correlation and convolutions, propagation and diffraction of optical waves, image forming systems with coherent and incoherent systems, optical filtering, holography and diffractive optics, and spatiotemporal processing of optical fields.

COURSE PREREQUISITES: Signal theory and electromagnetic Waves.

STUDENT LEARNING OUTCOMES:

At the completion of the course, students should be able to apply the basic engineering skills and mathematics to perform the design and analysis of optical systems based on the concepts of Fourier Optics.

REQUIRED MATERIALS:

Required Text:

Joseph W. Goodman, *Introduction to Fourier Optics* (W.H. Freeman & Company) Print ISBN: 9781319119164, 1319119166, Edition: 4th, Copyright year: 2017

Reference Texts:

Jack D. Gaskill, *Linear Systems, Fourier Transforms, and Optics* (John Wiley & Sons, 1978) ISBN 0-471-29288-5

NOTE: The student is also required to have access to a laptop computer, internet connectivity capable of transmitting and receiving video, a video camera, a microphone, and a cell phone.

TOPICAL OUTLINE:

1. Multidimensional Signals
 - a. Fourier Analysis
 - b. Linear Systems
2. Scalar Diffraction Theory
 - a. Electromagnetic waves
 - b. Rayleigh-Sommerfeld Diffraction
 - c. Angular Spectrum of Plane Waves
3. Fresnel and Fraunhofer Diffraction
 - a. Fresnel Approximation
 - b. Fraunhofer Approximation
 - c. Diffraction Patterns and Calculations

Exam 1 (Take Home)

4. Geometrical Optics
5. Spatial and Temporal Coherence
6. Coherent Optical Systems
 - a. Fourier Transform properties of Lenses
 - b. Image formation and Complex Optical Systems
7. Frequency Analysis of Optical Imaging Systems
 - a. Frequency Response of Coherent Systems
 - b. Frequency Response of Incoherent Systems
 - c. Comparison of Coherent and Incoherent Systems

Exam 2 (Take Home)

8. Optical Information Processing
 - a. Incoherent and Coherent Image Processing Systems
 - b. Optical Correlators
 - c. Acousto-Optic Signal Processing Systems
 - d. Pulse shaping and temporal processing
9. Holography and Diffractive Optics
 - a. Wave-front reconstruction
 - b. Computer Generated Holography
 - c. Diffractive Optics

Comprehensive Final Exam (Take Home)

Class Project: A project will be assigned and account for 20% of the course grade. The project abstract must be submitted no later than 1 month before the end of the class. This abstract must include the title and a brief description of the topic and its relationship to Fourier Optics and Optical Signal processing. The project will require a presentation and a written summary with all relevant references.

Homework: Homework is given to supplement the information presented in class. Independent thinking is encouraged on all homework assignments; however, some degree of interaction with other students is expected, but copying will not be tolerated. Additionally, no late homework assignments will be accepted without prior notification to the instructor.

GRADING POLICY: Grade Scale: 90-100 A, 80-89.9 B, 70-79.9 C, 60-69.9 D, 50-59.9 F.

Exam 1	20%
Exam 2	20%
Project	20%
Homework	10%
<u>Final Exam</u>	<u>30%</u>
Total	100%

ATTENDANCE POLICY:

1. This class will utilize a Hybrid/Blended Instructional Method. However, all of the classes will be available through the internet and will be subsequently posted through CANVAS for further access. Class attendance is not mandatory; however, students will be held accountable for the subject matter. Please note that the University may convert and continue with a purely online mode at any time. University classes are initially in a purely online mode and will remain so until Sept. 21.
2. In the event of a class cancellation, students will be notified through CANVAS and effort will be made to cover the course content in a subsequent session.
3. In the event a face to face meeting is desired, face coverings are required in all buildings and classrooms. Face coverings are also required in outdoor spaces where physical distance cannot be guaranteed. If a student does not have a face covering or refuses to wear an approved face covering without valid documented accommodation, the instructor will ask the student to leave the academic space and may report the student's actions to the Office of Community & Ethical Standards as a violation of the Student Code of Conduct. If the student's actions disrupt the class to the extent that an immediate response is needed, the instructor may call the Clemson University Police Department at 656-2222.
4. To maintain physical distancing, individuals arriving first to the classroom should sit farthest from the door. Similarly, at the conclusion of class, students closest to the door should leave first.

ACCESSIBILITY STATEMENT: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: <http://www.clemson.edu/campus-life/campus-services/sds/>.

TITLE IX STATEMENT: Clem[son University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972.

SAFE CAMPUS: Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

- a. Ensure you are signed up for emergency alerts (<https://www.getrave.com/login/clemson>)
- b. Download the Rave Guardian app to your phone (<https://www.clemson.edu/cusafety/cupd/rave-guardian/>)
- c. Learn what you can do to prepare yourself in the event of an active threat (<http://www.clemson.edu/cusafety/EmergencyManagement/>)

ACADEMIC INTEGRITY: As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the *Undergraduate Announcements* and in the *Graduate School Policy Handbook*.

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MODIFICATION STATEMENT: The instructor reserves the right to modify any aspect of the syllabus at any time during the semester for reasons including but not limited to COVID-related situations.