

Optics
Physics 360
Gustavus Adolphus College
Spring 2019

Instructors: Chuck Niederriter, Paul Saulnier, & Tom Huber

Office: Olin 211, 209, 208

Textbook: *Optics*, Eugene Hecht, Fifth Edition

Recommended Reference: *Principles of Optics*, Born and Wolf

Course Policy and Evaluation

1. **Lecture & Recitation:** The class will meet Monday, Wednesday, and Friday for lecture, recitation and homework review. The student is expected to read the assigned chapters in the text **before** coming to class. See the schedule for reading assignments. Lab meets on Wednesday or Thursday afternoon at 2:30 or 1:30 pm in Olin 112.
2. **Homework:** Problems will be assigned from each chapter, graded, and returned to the student. Late homework will be accepted at the discretion of the instructor and with some reduction in credit.
3. **Exams:** There will be three one-hour exams and a two-hour final exam. Students are expected to arrange in advance to take an examination at other than the announced time. Permission to make up a missed exam "after the fact" will be at the discretion of the instructor, and cannot be assumed.
4. **Quizzes:** There will be several unannounced ten-minute quiz throughout the semester based on the assigned reading.
6. **Laboratory:** There will be seven required laboratory experiments and an Optics Lab Project as described in the laboratory portion of the syllabus. Each group will be expected to keep a good laboratory notebook and turn in one short formal paper on each experiment and for the project.
7. **Attendance:** Regular attendance at all lectures and laboratories is expected and excessive absenteeism will result in some reduction of final grade. Participation is expected and is part of the student's final grade.
8. **Incompletes:** A grade of incomplete will only be given for work not completed due to circumstances beyond the control of the student.
10. **Office Hours, etc:** My scheduled office hours are 1st and 2nd hour on Tuesday and Thursdays. I will be available during these times for individual assistance and advising. I will also be available at other times by appointment. Call, email, or text. In general, if you want to stop in and you see me in the office, feel free to ask for help. If I can't help you then, I'll suggest some later time. Don't be afraid to ask for help.

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11. **Academic Honesty:** Having signed and agreed to abide by the College's Honor Code, students thereby pledge that, in all academic exercises, examinations, papers, and reports, they shall submit their own work. Footnotes or some other acceptable form of citation must accompany any use of another's words or ideas. In the context of this course, students are expected to collaborate and to discuss their out-of-class assignments. However, submitting under one's own name work that is merely copied from another is a violation of the Honor Code. (The full text of the Gustavus Academic Honor Code Policy may be found in the Gustavus Academic Bulletin). Not all components of this course are subject to the Honor Code. The instructor will clearly identify to which items the Code applies. But the student is responsible for requesting clarification if necessary.
12. **Accessibility Services:** Gustavus Adolphus College is committed to ensuring equitable and inclusive learning environments for all students. If you have a disability and anticipate or experience barriers to equal access, please speak with the accessibility resources staff about your needs. A disability may include mental health, attentional, learning, chronic health, sensory, physical, and/or short-term conditions. When appropriate, staff will guide students and professors in making accommodations to ensure equal access. Accommodations cannot be made retroactively; therefore, to maximize your academic success at Gustavus, please contact them as early as possible. Accessibility resources staff are located in the Center for Academic Resources and Enhancement (<https://gustavus.edu/care/accessibility/>) (x7227). Accessibility Resources Coordinator, Katy Clay, (clayk@gustavus.edu), can provide further information.

13. Evaluation:

Hour Exams	40%	A	94 - 100	C+	74 - 78
Final Exam	20%	A-	90 - 94	C	70 - 74
Homework	20%	B+	86 - 90	C-	66 - 70
Lab & Project	20%	B	82 - 86	D+	62 - 66
		B-	78 - 82	D	58 - 62

Assignment of final letter grades will also take into account the instructor's subjective evaluation of the student's attendance, initiative, class participation, preparation, and evidence of improvement.

14. Notes:

The instructor's job in this class is to help you learn Optics. I would encourage you to ask questions about the material during class and speak with me outside of class to discuss any course related concerns. Don't wait until the end of the semester to inform me of your concerns - by then it is too late. Your opinion is important to me.

The background of the students in the class is varied, some have had E&M and Quantum while others have not. This will present a challenge to all of us. I will try not to assume things which are an integral part of the text or a standard optics course. This means that some material may be a review for some of you, please be patient!

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Course Syllabus

<u>Week Beginning</u>	<u>Chapter</u>	<u>Title</u>
February 11	Chapters 2 & 3	Wave Motion & Electromagnetic Theory, Photons, and Light
February 18	Chapters 3 & 4	E&M Theory and The Propagation Of Light
February 25	Chapters 4 & 5	The Propagation Of Light & Geometrical Optics - Paraxial Theory
March 4	Chapter 5 & 6	Geometrical Optics-Paraxial Theory & More On Geometrical Optics
March 11	Chapter 6 & 7	More On Geometrical Optics & The Superposition of Waves
March 15	*** Exam 1 on Chapters 2 - 6 ***	
March 18	Chapter 7	The Superposition Of Waves
March 25	Chapter 8	Polarization
March 30 – April 7	***** Spring Break *****	
April 8	Chapter 9	Interference
April 15	Chapter 10	Diffraction
April 22	Chapter 10	Diffraction
April 24	*** Exam 2 on Chapters 7 - 10 ***	
April 29	Chapter 10 & 11	Diffraction & Fourier Optics
May 6	Chapters 11	Fourier Optics
May 13	Chapters 12 & 13	Fourier Optics & Contemporary Optics
May 17	*** Exam 3 on Chapters 11, 12, & 13 ***	
May 20	Presentations and Review	
May 24 1:00 pm	*** Comprehensive Final Exam ***	

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LABORATORY

INTRODUCTION:

You are a research physicist during the 21st century. Your job is to conduct experiments, make discoveries, and publish results. You hope to become famous and win a Nobel Prize before the age of thirty, so the quality of your publications is very important. The results of your research are to be published in Optics Letters. As the name implies this journal accepts results published in “scientific letter” style (see attached example). You are to publish your results in Optics Letters and orally defend your experimental results in 10 minute scientific presentations (see attachment). Good luck making history!

INSTRUCTOR'S NOTES:

Philosophy of Reports - I want you to take your role as a research physicist seriously! I am the editor of the journal in which you are trying to get your papers published. Whether or not your papers are accepted for publication (and your lab grade) depend on how well the paper is written and the quality of the scientific evidence you present to support your findings. You must convince me that your results are real and not just experimental noise!

Freedom - This method of conducting a laboratory has been chosen to give you considerable freedom in the planning, execution, and presentation of experiments. I wanted to avoid “cookbook labs”. You decide what to present or include in your paper and what not to. One laboratory/research notebook is to be kept by each group - it will be collected for grading at midterm and at the end of the semester. Full points will be given for an Experimental Modern acceptable notebook.

Group Size - You are to work in groups of two. One joint paper per group.

Safety - Observe safety precautions at all times. You will be taught appropriate laboratory safety procedures the first day of lab.

Equipment - The equipment is expensive and in short supply so I ask you to treat it with appropriate respect. You will be taught correct handling procedures. Each group will be issued an “optics tool kit” which will be inventoried at the beginning and end of the course. It is your responsibility to care for and keep track of all equipment and optical components in your kit.

Final Project - Each group will do a laboratory project during the final weeks of the semester. The results of this project will be presented orally and submitted in letter format.

Described below are the two methods that you will use to present your experimental results.

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I. Scientific Letter Format - The scientific letter style of presenting experimental results is a short paper used to announce significant new findings or discoveries (see example which follows). The paper should be no longer than three typed pages or its equivalent and should contain the following items. The paper should have a title, statement of authorship, abstract, body, and a reference list. The abstract is a brief summary statement about what was done and the significant results that were obtained. The body of the paper should contain an introductory paragraph that places the work in context and states why it is important. Next the experimental setup (no procedure information), results, data analysis, and theory are described. You are trying to convince the reader that you know what you are talking about. Include anything that you feel supports your conclusions, for example, data tables, diagrams, graphs with captions, and equations. Finally, the body of the text should include a concluding paragraph which restates the most important results or findings. Any references used should then be listed. All figures should have complete captions so that the reader can understand what is being shown without referring back to the main text.

II. Oral Presentation of Experimental Results - Due to the large number of scientists working today a brief oral presentation style has been developed, called “the 10 minute talk”. This is an oral presentation in which the scientist is given 10 minutes to state his or her case and the audience is then given 5 minutes for questions. The presentations usually include very short text, graphs, tables, and equations as appropriate. These talks are usually given using overhead transparencies. Practice your talk before giving it to the class since ten minutes goes by very quickly and you will therefore only have time to include the most essential things (8 to 12 transparencies is usually appropriate).

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Laboratory Schedule

February 13 & 14	LABORATORY I	Introduction to Optics Lab
February 20 & 21	LABORATORY II	Introduction to Fiber Optics
February 27 & 28 March 6 & 7	LABORATORY III	Waves At An Interface
March 13 & 14	LABORATORY IV	Superposition of Waves
March 20 & 21 March 27 & 28	LABORATORY V	Polarization
April 10 & 11 April 17 & 18	LABORATORY VI	Interference
April 24 & 25 May 1 & 2	LABORATORY VII	Diffraction
*****<u>April 15</u>	<u>Project Proposal Due</u>	<u>One Page</u> *****
May 1 & 2 May 8 & 9 May 15 & 16	PROJECT	Student's Choice