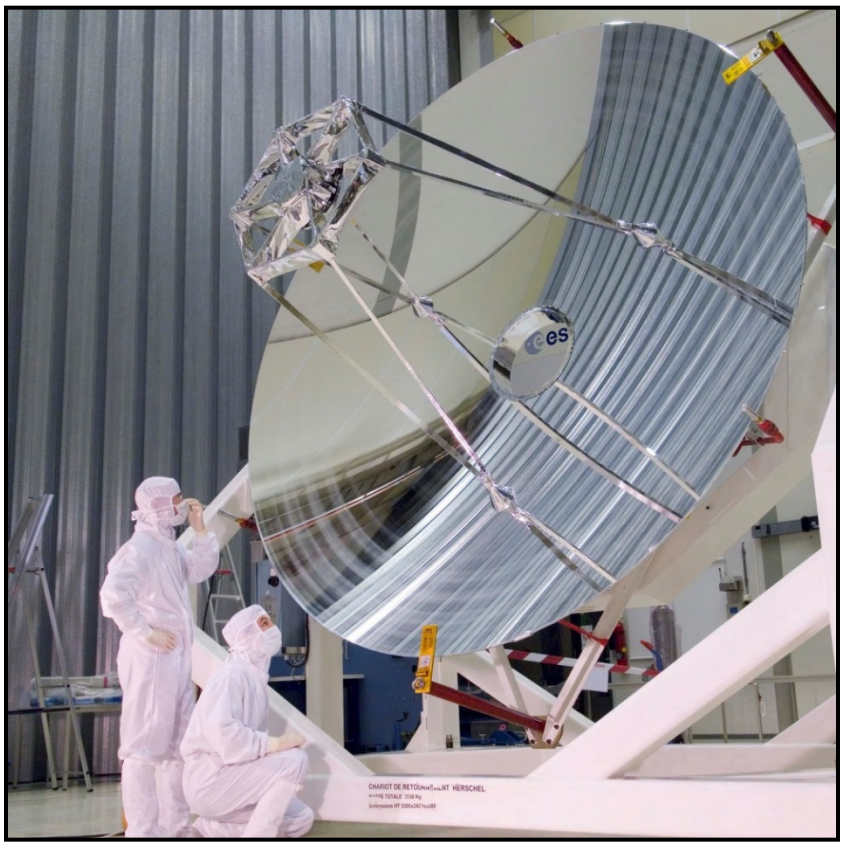
University of Alaska Fairbanks Spring 2019

Physics 462

Geometrical and Physical Optics (4 Credits)

Instructor – Dr. Mark Conde



http://www.acc.co.uk/raes/space/images/008-037_H,0.jpg

Overview

Description

This class will cover a broad range of topics in optics, including the nature and propagation of light; geometrical optics with mirrors, prisms, and lenses; polarization; superposition and interference; diffraction theory; nonlinear optics; Fourier optics; and coherent wave theory. These concepts will be covered in three one-hour lectures per week plus one three-hour laboratory session.

The course will follow the assigned textbook (Hecht) very closely. The emphasis in class will be on key concepts, rather than on complex mathematical derivations or proofs. Nevertheless, students will be expected to demonstrate mastery of the underlying mathematics in homework and exams.

Some topics will likely receive additional emphasis relative to that given by the textbook. These include compound thick lens systems, basic optical design, aberrations, and familiarity with common optical instruments.

Course goals and student learning outcomes

Upon completion of this course students will be familiar with:

- The basic physics of light propagation;
- Geometrical optics, and optical systems;
- Physical optics, including interference and diffraction;
- Optical instrumentation and capabilities;
- Principles of optical design;
- Practical laboratory techniques for optical testing and measurement.

My goal as an instructor is to provide every student with maximum possible opportunity for success. This means that I try to be as flexible as possible with the course requirements, to avoid creating needless hurdles. Nevertheless, some penalties for missed or late work are necessary; my policies in this regard are outline below.

Instructor information

Instructor:	Dr. Mark Conde
Office locations:	Reichardt room 110 & 113 and Elvey room 706C.
Office Phone:	474-7741
Email:	mgconde@alaska.edu
Office hours:	I do not intend to establish fixed office hours for this small class. I will always be available immediately after lectures, or at other times by arrangement. If you need to see me, speak to me after class or send me an email, to setup a time.

Approximate schedule

Week	*Dates*	*Class Topics*	*Lab Sessions*
1	Jan 14 - Jan 18	Class introduction; Hecht. chapter 2	
2	Jan 21 - Jan 25	Hecht chapters 3,4	Lab 1
3	Jan 28 - Feb 01	Hecht chapter 4	Lab 2
4	Feb 04 - Feb 08	Hecht chapter 5	Lab 3
5	Feb 11 - Feb 15	Hecht chapter 5	Review for exam
6	Feb 18 - Feb 22	Exam 1 (Wed). Hecht chapter 6	Lab 4
7	Feb 25 - Mar 01	Hecht chapter 6	Lab 5
8	Mar 04 - Mar 08	Hecht chapter 8	Lab 6
9	Mar 11 - Mar 15	Spring Break	
10	Mar 18 - Mar 22	Hecht chapter 8,7	Lab 7
11	Mar 25 - Mar 29	Hecht chapter 9	Review for exam
12	Apr 01 - Apr 05	Exam 2 (Wed). Hecht Chapter 9	Lab 8
13	Apr 08 - Apr 12	Hecht chapter 10	Lab 9
14	Apr 15 - Apr 19	Hecht chapter 10	Lab 10
15	Apr 22 - Apr 26	Hecht chapter 11	Lab 11
16	Apr 29 - May 03	Hecht chapter 12, review	Review for exam
17	May 06 - May 10	Finals week	
18	May 13 - May 17	Grades posted.	

Course components and instructional methods

Course materials

Material for this course will be prepared electronically and will be available *over the web via the "Blackboard"*[1] *system* at https://classes.alaska.edu/. Material to be posted this way includes:

- Course syllabus (this document)
- Lecture notes (see comments below)
- Homework problem sets
- Lab notes
- Supplementary handouts
- Online student grades

Note that I will not be distributing homework or exam solutions to the web. These will instead be posted in the glass cabinets in the physics departmental area of the Reichardt building.

Lectures

Lectures will be held on Monday, Wednesday, and Friday from 11:45 AM to 12:45 PM in room 207 of the Reichardt Building. The lectures will follow closely the material in the textbook. It is recommended that you read the chapters beforehand, and take notes during the lecture. The emphasis in the lectures will be on clarification of the key concepts in the book, rather than lengthy mathematical derivations.

[1] All students should have access to Blackboard. Please let me know if you have difficulties with this.

I will be presenting lectures using a combination of computer and blackboard. I intend to post electronic lecture notes online as well, provided this does not appear to be adversely affecting lecture attendance.

Homework

Homework will be assigned each week during the Friday lecture and will be due at the start of the following Friday's lecture. Hand your homework to me at that lecture. You are encouraged to work with others, but you are prohibited from simply copying other's work. Homework will count heavily toward your final grade, as well as provide me with feedback regarding your understanding of the material.

Problems assigned in this class can often be solved in several ways, with each solution involving a number of steps. So please be aware that even if you submit a correct solution to a problem, I may not recognize it as correct if it's poorly presented. While I will accept almost any work that you turn in, it is unlikely that I'll award many points for a homework or exam solution unless it:

- Is neatly laid out
- Is largely free from crossing out and over-writing
- Is accompanied by **descriptions in words of what you are doing at each step**

Indeed, this year I will introduce a formal **requirement** for each homework problem to be accompanied with verbal explanations of the major mathematical steps. This is a 400-level class, which means students should be preparing either to enter the professional workforce or to begin graduate school. Both of these environments require clear, coherent, and unambiguous communication – as will this class. The point of submitting homework solutions is not to tell me the final answer. (I already know that.) The point is to demonstrate that you can explain clearly and professionally *how that answer is obtained*.

A minimum cumulative grade of 50% for the homework is necessary to pass the class. All students should be capable of achieving this, given that I generally award a minimum of at least 25-30% for any genuine attempt at a problem. But please note – the remaining points for the problem will be weighted heavily according to my assessment of *how well you have explained the process* of obtaining the solution.

Solution sets will be posted in the glass cabinet in the Physics Dept. hall. You are strongly encouraged make copies to help you understand how to approach these problems; it will likely help on tests.

Laboratory work

This class has an associated laboratory component, consisting of one 3-hour lab period each week. The lab is currently scheduled for 8:30-11:30 on Thursdays. However we are the only users of this room, so we are free to reschedule the lab time as we wish – provided **all** class members and the instructor agree on the new time. There will be no lab session on the first day of class, or during the weeks immediately prior the midterm and final exams. These sessions will be available for study and review with the instructor.

There will be eleven lab experiments. You must attend and submit a written report for at least 10 labs. A passing grade in the labs is necessary to pass the course.

Note that this year I will be experimenting with a new format for Lab reports. I will not be requiring complete, traditionally formatted reports for every Lab. Instead, I will only require these for roughly every third lab. For the others, I will instead distribute a "worksheet" that you must complete. This is an attempt to reduce the time burden that Lab reports have created for students in previous years.

Reports or worksheets from a given lab will be due at the start of the lab session in the following week. Please understand that in grading the reports, I am not looking to see if you "got the right answer" from your measurements; that aspect of my grading carries negligible weight. The aspects of your lab work that I will be assessing are:

- Have you demonstrated that you understand the technique?
- Have you described what you did clearly and completely enough that someone else could repeat your measurements and subsequent analysis of results?
- Have you included sufficient error analysis to allow you to state with confidence the uncertainties associated with all your numerical results?
- Do you understand the results? Are they plausible? If not, have you identified possible reasons for this?
- Is the report clear, complete, and well presented?

A well-written lab report should be concise – but do not confuse "concise" with "sparse". Your report must be complete, and must include sufficient detail to allow others to repeat your work, based solely on what you have written. If you receive a low grade for a report, I will allow you to revise it and resubmit it one week later to be re-graded, if you wish.

Exams

There will be two one-hour exams during the semester and one two-hour final. The preliminary dates for these exams are

- Exam 1: Wednesday February 20, 11:45 am to 12:45 pm;
- Exam 2: Wednesday April 03, 11:45 pm to 12:45 pm;
- Final: 10:15 a.m.-12:15 p.m., Wednesday, May 1.

Complex formulae and physical constants will be provided for exam problems that require them. No textbooks will be allowed in exams, but you may bring in any amount of your own original (not photocopied) handwritten notes.

Course policies

Grading

The course grade will consist of the following components

- Two one-hour midterm exams 20% (10% each exam)
- One two-hour final exam 15%
- Homework 35%
- Lab 30%

I will post all grades online, using the UAF's "Blackboard" system (https://classes.alaska.edu/). All registered students have access to this system for checking their grades.

Final grades will be returned as letter grades with plus/minus modifiers. These will be derived from your overall percentage grade. The approximate conversions for each letter grade will be as follows. A: ≥90%; B: 75% to 90%; C: 60% to 75%; D: 50% to 60%; F: <50%. Plus/minus modifiers will subdivide each main grade into three equally spaced sub-levels.

Attendance

Your laboratory work can only be performed if you are actually present in the labs. Thus, by Physics Department policy, attendance is an absolute requirement for the laboratory portion of this class. By contrast, you can make up for an occasional missed lecture by reading the textbook. Nevertheless, UAF policies[2] include statements that:

- "you must begin attending classes on the first day of instruction or you may lose your place, regardless of whether or not you have paid tuition and fees"
- "you are expected to adhere to the class attendance policies set by your instructors"

In general, I expect at least 90% attendance from all students. Extended periods of consistent absence may lead to a penalty in your overall grade, depending on circumstances.

Class participation

There is no requirement for you to participate actively in class by asking questions or joining discussions, and there is no grade component based on this. Nevertheless, you are of course free to ask questions at any time during the lectures. Because we have a large amount of material to cover, I may defer answering lengthy or numerous questions until after class.

Missed or late work

Two midterms and a final exam will be given in this course. In the case of documented illness, clash with another UAF commitment, or other emergency, a make-up exam may be given, at the discretion of the instructor. An unexcused absence for an exam will lead to 0 points earned on that exam.

Because the lab sessions are small and relatively informal, I may at my discretion allow students to work through a missed lab at an alternative time. I will only do this in cases of genuine need. Further, because each experiment is normally only setup during the week it's being performed, any such make-up sessions would normally have to occur within a few days of the missed lab. Penalties for unexcused absence from labs may be severe, up to and including the awarding of a failing grade.

Problem sets will generally not be accepted after the due date, without documented evidence of illness or genuine emergency. Students having documented clashes with other UAF commitments may pre-arrange alternate homework submission deadlines with me. All decisions regarding late homework or alternate deadlines will be at the discretion of the instructor.

Student conduct and academic honesty

It is the responsibility for each student to be informed about the policies for student conduct and safety at the University of Alaska. You are encouraged to read these policies at https://www.uaf.edu/student-affairs/student-resources/conduct.php#condu. It should go without saying that students are expected to do their own original work for all assignments. Any deviation from this may be considered academic misconduct and may result in a failing grade and referral to university authorities for possible disciplinary action.

---

[2]See http://catalog.uaf.edu/academics-regulations/attendance/ and https://www.uaf.edu/register/services.php#attend

Course requirements and materials

Prerequisites

Prerequisites: PHYS F213X; PHYS F301; or permission of instructor.

Required text

Optics, 3rd, 4th or 5th editions, by Eugene Hecht. (Addison Wesley)

Note that I personally will be using the 4th edition of Hecht. It is ok to use the 3rd or 5th editions, but please let me know so I can check if there are any critical references to pages/chapter sections etc that are different.

There are no other supplementary texts assigned, although there are plenty of other good optics textbooks if you find you need additional explanations.

Technology Requirements

Course materials will be delivered via Blackboard, which means students will require easy web-browser access to the internet. Most material will be delivered in PDF format, so that students will need access to Adobe Acrobat Reader or other third-party equivalent software.

A simple digital camera or cellphone camera may be useful (but not absolutely required) for recording setups and results during lab sessions.

Calculators will be permitted (and required) during exams. There will be no need for anything elaborate; an easy-to-use scientific calculator with trigonometric, exponential, and logarithmic functions is all that you will need. Remember that it is much more important to present the correct formulae and reasoning for solving a problem than it is to arrive at the correct numerical value. Please, explain your reasoning when presenting solutions to homework and exam problems. I will award partial points for correct reasoning, if presented, even if the final answer is incorrect or incomplete.

In general, it is better to work with algebraic variables whenever possible; numerical values should not be substituted in until absolutely necessary.

Other issues

Complaints and concerns

You are always welcome to discuss your concerns with me. However, if you have a concern that you feel cannot be resolved by discussion with me, you may wish to contact the Physics Department chair, Dr. Wackerbauer. If your concern cannot be resolved at the department level, you may also discuss the matter with the Dean of the College of Natural Science and Mathematics.

Disabled students

Disability services are provided free of charge, and are available to any student who qualifies as a person with a disability. Student seeking special accommodations for a disability must first discuss their needs with Disability Services. Call 474-5655 to schedule an appointment.

UAF Disability Services is located in the Whitaker Building, room 208. Extensive support is available, as described at http://www.uaf.edu/disability/

REQUIRED INFORMATION FOR UNDERGRADUATE SYLLABI

STUDENT PROTECTIONS AND SERVICES STATEMENT:
Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc. to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. As required, if I notice or am informed of certain types of misconduct, then I am required to report it to the appropriate authorities. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: www.uaf.edu/handbook/.

UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: https://alaska.edu/nondiscrimination/.

Your instructor follows the University of Alaska Fairbanks Incomplete Grade Policy: "The letter "I" (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the student's control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an "I" grade."

Effective communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication's Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English's Department's Writing Center (907-474-5314, Gruening 8th floor), and/or CTC's Learning Center (604 Barnette Street, 907-455- 2860).

ADDITIONAL INFORMATION

The University of Alaska has detailed and ever-changing requirements for courses and course syllabi. The purpose of this statement is to indicate that, in addition to requirements explicitly stated here, all other current overarching UAF policies also apply to this course – whatever the heck they may be this time around….