University of Alaska Fairbanks Fall 2016

Physics 213

Elementary Modern Physics

Instructor – Dr. Mark Conde

A 1929 cartoon:

"People slowly accustomed themselves to the idea that the physical states of space itself were the final physical reality."

-- Professor Albert Einstein

(Drawing by Rea Irvin; © 1929 The New Yorker Magazine, Inc.)

Course description

Overview

This is an introductory course in modern physics. Topics to be covered are specified in the UAF course catalog as follows: Geometrical and physical optics, elementary-level modern physics including special relativity, atomic physics, nuclear physics, solid-state physics, elementary particles, simple transport theory, kinetic theory and concepts of wave mechanics.

The course will follow the material in the two textbooks (see below) for both scope and depth of coverage. However, due to the very wide range of topics covered, the emphasis in lectures, quizzes, and exams will be on understanding basic concepts rather than on detailed mathematical derivations and proofs.

Approximate schedule

Week	*Dates*	*Topics*	*Labs*
1	Aug 29 - Sep 02	Class introduction; Geometrical (ray) optics.	No labs
2	Sep 05 - Sep 09	Ray Optics, Waves, Superposition	1
3	Sep 12 - Sep 16	Interference, Diffraction	2
4	Sep 19 - Sep 23	Polarization, Optical Instruments	3
5	Sep 26 - Sep 30	Failures of Classical physics, Relativity	Recitation
6	Oct 03 - Oct 07	Relativity, Exam 1 (Wednesday).	4
7	Oct 10 - Oct 14	Relativity, cosmology	5
8	Oct 17 - Oct 21	Waves and Particles	6
9	Oct 24 - Oct 28	Schrodinger Equation and its simple applications	7
10	Oct 31 - Nov 04	Schrodinger Equation in three dimensions	Recitation
11	Nov 07 - Nov 11	The hydrogen atom, Exam 2 (Wednesday)	8
12	Nov 14 - Nov 18	Atomic Physics	9
13	Nov 21 - Nov 25	Atomic physics, Thanksgiving Week	Make-up
14	Nov 28 - Dec 02	Statistical mechanics	10
15	Dec 05 - Dec 09	Nuclear and particle physics	Recitation
16	Dec 12 - Dec 16	Finals week. Final exam Wednesday May 8,1-3 pm.	No labs

All students should understand that this schedule is an approximate target. The actual pace of topic coverage may vary, depending on the depth of class interest in each one. Please note: there are no labs during the first week of semester.

Course goals and student learning outcomes

Upon completion of this course students will:

- Understand how classical physics fails to explain the fundamental nature of physical interactions, particularly at atomic scales and at high energies.
- Understand the basic behaviors of light and optics, as an example of a topic that bridges the realms of classical and modern physics.

- Become familiar with the two main theoretical advances that address the shortcomings of classical physics: relativity and quantum mechanics.
- Appreciate how these new tools can be applied in frontier areas like cosmology, and atomic, nuclear, and particle physics.
- Learn how to apply the new tools of modern physics to solve simple quantitative problems in these areas.
- Appreciate the history societal relevance of modern physics.

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 outlined below.

Instructor information

Instructor:	Dr. Mark Conde	
	Email:	mgconde@alaska.edu
	Office locations:	Reichardt room 110 and Elvey room 706F.
	Office Phone:	474-7741
	Office hours:	10 am to 12 AM Mon Wed, Fri in Reichardt 110, or immediately after class on these days. (You can also see me in Elvey room 706F, by arrangement.)
Teaching Assistant:	Carl Andersen:	Email: csandersen@alaska.edu, Office hours in REIC room 126
Lab Manager:	Jean Talbot:	Email: j.talbot@alaska.edu, Office: REIC room 114.) Phone: 474-7857
Office Manager:	Ellen Craig:	Email: eacraig@alaska.edu Office: Reichardt room 102.) Phone: 474-7339

Course requirements and materials

Prerequisites

Placement in ENGL F111X or higher; MATH F252X; MATH F253X; PHYS F211X; PHYS F212X; or permission of instructor. Extensive use will be made of algebra, trigonometery, and calculus.

Required Texts

Physics for Scientists & Engineers w/Modern Physics 3rd Ed., Knight
Modern Physics, 3rd Edition, Kenneth Krane

Note that the Knight book will be used only for the optics section of the course, which we cover at the beginning. This is the same book as we use for PHYS211 and PHYS 212, so I presume many or most students will already have a copy. If not, you can probably get by with only the material I will be posting online as lecture notes and problem sheets. I also

very much like the older book that we used for this course last time I taught it, i.e. *Nonclassical Physics*, by Randy Harris. This book gives more depth and insight than the one by Krane but, on the flip side, it is harder work to read and understand it.

Instructional materials

Material for this course will be prepared electronically and will be available *over the web via the "Blackboard"*[1] *system* at http://classes.uaf.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.

Calculators

Calculators will be permitted 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 obtain the correct formulae for solving a problem than it is to arrive at the correct numerical value. In general, it is better to work with algebraic variables whenever possible; numerical values should not be substituted in until absolutely necessary.

Course components

Lectures

I will be presenting lectures mostly using a computer, although I will supplement this with additional informal diagrams etc. drawn on the blackboard. I intend to post printable versions of the electronic lecture notes online ahead of time, provided this does not appear to be adversely affecting lecture attendance.

Lectures will be held on Monday, Wednesday, and Friday from 1 pm to 2 pm in room 138 of the Reichardt building. You should read the lecture notes and the relevant chapter from the textbook beforehand. I strongly recommend bringing printed versions of the notes to class, and annotating them with your own supplemental notes during the lecture.

Labs

Labs will be held on Thursdays between 9:30 am and 12: 30 pm in room 253 of the Reichardt building. There will be ten lab sessions and three recitations – which are problem solving classes used to prepare for exams.

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

No regular lab sessions are scheduled on the week of Thanksgiving. We will instead use Thanksgiving week as a chance to do makeup labs. Because Thursday is a holiday during Thanksgiving week, we typically aim to run the makeup labs during 9:30 – 12:30 on Tuesday of that week instead. Experience has shown that this time usually works for everyone but, if not, we can make accommodations. Lab sessions in the final week of semester will be used as recitations in preparation for the final exam.

Lab exercises be completed during the lab, and turned in to the TA at the end of the session. Laboratory sessions are a vital part of this course, and should not be missed. ***Physics Department policy sets an absolute requirement for you to attend every lab, and to submit notebooks or reports for all of them.*** Failure to do so will automatically result in a failing grade for the course. Makeup opportunities are provided[2] in the event that you are unable to attend a lab.

Complete lab policies are outlined in more detail in a separate document that will be available from the PHYS213 Blackboard site.

Homework

Homework problems will be assigned and posted to Blackboard each week by the time of the Wednesday lecture. Your solutions will be due by 5:00 pm on Wednesday of the following week. An exception to this is that no homework will be assigned for the week preceding an exam; this is to allow you time to study for the exam instead. ***All homework must be submitted via the box for this class that is located in the physics departmental office***. Please do not put homework in my departmental mailbox, as this will delay getting it to the TA for grading. You may work with others, but you are prohibited from simply copying other's work. Homework will count significantly toward your final grade, as well as provide me with feedback regarding your understanding of the material.

Please realize that even if you submit a correct solution to a problem, your grader may not recognize it as correct if it's poorly presented. To maximize your chance of scoring well, your homework must:

- Be neatly laid out
- Be largely free from crossing out and over-writing
- Use grammatically correct English and be well enough written that the grader can understand what you're trying to say

Note that there are often many ways to solve a given problem, some of which may not have occurred to either your instructor or your grader. It can be extraordinarily difficult to understand what a student is doing in a solution if it is messy and contains no explanatory text. The more carefully and completely you explain your solution, the more likely it is to receive a high score.

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.

[2] Generally we only *guarantee* to provide an opportunity to make up *one* lab. But in cases of documented hardship or unavoidable clashes with other University commitments we will find ways to ensure that your lab requirements can be met.

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 October 5, 1 – 2 pm
- Exam 2: Wednesday November 9, 1 - 2 pm
- Final: Monday, December 12, 3:15 - 5:15 pm

All exams will provide a list of potentially useful formulae. No textbooks will be allowed in exams, but you may bring in any amount of your own handwritten notes.

Assessment policies

Grading

The course grade will consist of the following components

Two one-hour exams	30% (15% for each of two.)
Two-hour final exam	30%
Homework	20%
Lab	20%

I will post all grades online, using the UAF's "Blackboard" system (http://classes.uaf.edu). All registered students have access to this system for checking their grades. Please do *check that we have posted all your grades correctly*, and let me know if you think there is an error. Also, please retain all work that we return after grading, in case an error does appear. Returned graded work is proof of your scores.

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, attendance is an absolute requirement for the laboratory portion of this class.

UAF policy[3] states that "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. If attendance becomes a concern I may need to respond, for example by introducing unannounced "pop quizzes" to allow me to reward those who do attend regularly. Extra credit will be given for points scored on any such quizzes. Initially, I am not planning to record attendance at lectures. However, I will certainly notice repeated absences in this small class and may begin keeping attendance records if truancy does become a problem. Documented absence from more than half of the lectures may result in a failing grade.

[3] See http://catalog.uaf.edu/academics-regulations/attendance/

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.

Exam and homework make-up policy

In the case of documented illness or 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.

Problem sets will generally not be accepted after the due date, without 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 http://www.uaf.edu/usa/student-resources/conduct/#condu. It should go without saying that students are expected to do their own original work for all assignments. Copying from other students or indeed from any source that is not your own work constitutes plagiarism. Failure to comply with UAF policies may be considered academic misconduct and may result in a failing grade (either for individual portions of work, or for the entire course, depending on severity.) Serious cases will be referred to university authorities for possible further disciplinary action.

Support services

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. The University also has an Academic Advising Center on the 5th floor of the Gruening building, open Monday to Friday, 8 am to 5 pm and contactable via phone at 907-474-6396. The advising center can help with all student matters, from study tips to help with understanding the University's formal mechanisms for academic appeals. (See also http://www.uaf.edu/advising/)

Student Health and Counseling Center

The University provides health and counseling services through its Student Health and Counseling Center, which is located at 612 N. Chandalar Drive, on the 2nd floor of the

Whitaker Building (the same building as Fire and Police, across from the bus turn around.) Their web site is at http://www.uaf.edu/chc/. The center will see students on an appointment basis. The number to call for an appointment is 474-7043. It is best to do so at 8:00 AM in the morning, because they are scheduled daily on a first come first serve basis.

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/