

COURSE SYLLABUS:
“MODERN PHYSICS”
Physical discoveries of the past 110 years

Physics 225
Calculus-level investigation of the theories
of relativity and quantum mechanics

Course Title: Modern Physics

Web Page: <http://www.instruction.greenriver.edu/physics/keith/225>

Instructor: Keith Clay

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Office hours:	Monday and Thursday	9:00 AM - 11:00 AM
	Wednesday	1:00 PM - 2:00 PM

Class Meetings:

Mon, Tue, Thu	SC 117	3:00 PM – 3:50 PM
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Prerequisites: The prerequisites for this course are Physics 202 (or 111) and Math 125 or the equivalent. Both are absolutely required. Students should be concurrently enrolled in (or should have previously completed) Phys 203 (or 112) and Math 126 as well. Some material discussed in this course will draw upon elements from Physics 203 and 112, Math 240, and Math 238, but students will be able to pick up the material as it arises.

NOTE: During approximately the fourth week of the term, discussions will turn to light and radiation which will require some understanding of waves. Students studying modern physics who are NOT simultaneously taking Physics 203 or Math 238 should try to learn a little bit about waves, interference, and resonance. An introduction can be found in any good physics text, but an excellent introduction is in Chapter 16 of our textbook (*Physics for Scientists and Engineers*, by Serway and Jewett).

Assumed Competencies: Students taking this course must have already completed Physics 202 and Math 125 with satisfactory grades. It is assumed that these students will already be able to

- express and utilize basic principles of scientific investigation
- use units and dimensions as a tool for finding solutions and expressing results
- carefully and critically think through a scientific problem
- design an experiment to test a new hypothesis or play with a new idea
- express and utilize scientific ideas in both verbal and mathematical forms

Course Objectives: Since it is assumed that all students taking this course already have substantial scientific reasoning and investigation skills, the objectives for this course are very subject specific:

1. Students should be *familiar* with all four of Maxwell's equations and the Lorentz force law, understanding what each of these equations *means* and how each is used in physical situations.
2. Students should understand relationships between fields and potentials and some devices that rely upon them. Students should associate each of Maxwell's equations with at least one tool or device.
3. Students completing the course should be able to calculate quantities associated with electric and magnetic fields, although perhaps with "help" as in an "open book, open note" environment.
4. Students should be able to relate the wave equation to Maxwell's equations, and *derive* an expression for the speed of light from Maxwell's equations.

Relationship to Campus-wide objectives:

Green River Community College has identified several educational objectives for all courses and all students on the campus. The objectives of this course include many of these campus-wide objectives which will be directly and indirectly monitored and assessed. These overlapping objectives include enhancement of proficiency in the following areas:

1. **Critical thinking and problem solving skills:** If there were only one objective to this course it would not be the retention of any fact that is associated with the subject matter called physics. It would be the development of skills needed to analyze any problem carefully, logically, analytically and creatively, with a hopeful eye toward the creation of a viable problem solving strategy.

Critical thinking and problem solving skills will be assessed using homework assignments, quizzes, laboratory exercises, a class project, and ungraded assessment tests.

2. **Mathematical and quantitative reasoning:** Successful completion of this course requires the mathematical modeling of many complicated situations, often using models which are not intuitively obvious. Students often comment that physics courses stretch their ability to translate from the real world to mathematical abstractions and back again more than any other.

Mathematical and quantitative reasoning skills will be assessed using homework assignments, quizzes, laboratory exercises, a class project, and ungraded assessment tests.

3. **Clarity of communication and written expression:** Verbal exposition is often put to its most stringent test when technical material must be accurately and yet readably described. This course requires written discussion of highly technical subjects and precisely defined concepts, often blending the English language with the language of mathematics.

Communication and written expression skills will be assessed using homework assignments, quizzes, laboratory exercises, a class project, and ungraded assessment tests.

4. **Aesthetic appreciation:** The teacher of this class freely pursued the study of physics when a career in engineering or any number of other fields would have been much more lucrative and required less formal education. The reason for this was simply a deep and abiding love for the astounding beauty of the subject matter. Your teacher sincerely hopes that some appreciation of this beauty will rub off on each and all of his students, although aesthetic appreciation will not be directly assessed.

Aesthetic appreciation of physics will be assessed in part through the work done in preparing and presenting an in-class project of the students choice and design..

TEXTBOOK:

Understanding Physics, by Karen Cummings. (Used as a resource, only)

Physics for the 21st Century, by Annenberg Media. Available online at <http://www.learner.org/courses/physics/> (you do not need to buy or print anything from this site)

Modern Physics, by Frank J. Blatt, McGraw-Hill, 1992. This will be our primary textbook. You don't need to buy this book. This book will be available in the GRCC library for checkout for a few days. It is hoped that we will have enough books for the whole class to share. If you want to buy the book, used copies can sometimes be found online for a few dollars. ***As of this writing this textbook is also available for download from several online sites but the college cannot be responsible for the safety of your identity or your computer if you use these sites.***

Thanks to the hard work of your humble instructor, the GRCC library has a large collection of modern physics textbooks that you can check out from the reserve desk. You'll need to check to see how long you can keep them. These are to be used (and this is a requirement of the course) as supplemental reading material to help you search for answers to the questions that arise during the course.

Some of ADDITIONAL TEXTS are:

- *Modern Physics*, by Bernstein, Fishbane, and Gasiorowicz. This is a very well-written book. It makes for enjoyable reading.
- *Modern Physics*, by Harris. You might begin to notice a pattern in the titles of these books. Harris' book is very recent (© 2008) and thus includes some material missed by the others.
- *Modern Physics*, by Krane. This is perhaps the industry standard. It seems to be used by more universities than the other books.
- *Modern Physics*, by Ohanian. At Ohanian's insistence this book was reprinted in paperback shortly after publication. Used paperback editions can be found for a couple of dollars.
- *Modern Physics for Scientists and Engineers*, by Taylor, Zafiratos, and Dubson. This is a very complete and well-written book. Maybe tied with Tipler for 2nd place in terms of popularity.
- *Modern Physics for Scientists and Engineers*, by Thornton and Rex. This book gets some good reviews and some not-so-good. Used copies seem readily available.
- *Modern Physics*, by Tipler and Llewellyn. Now in the fifth edition, this one was the industry standard before Krane came along. Still very popular.
- *Principles of Modern Physics*, by Saxena. The word "Principles" does not mean that this is a simplified book. This book is detailed and written at a high level. All of modern physics is here, and strangely enough: most of it is available ***for free*** on Google books! Check it out.

Laboratory requirement:

As a class we will work through a couple of modern physics experiments. We will measure the photoelectric effect, the Franck-Hertz experiment, and microwave diffraction. Technically there is no “lab credit” associated with this class but these experiments are too important to ignore them. Participation in ONE OF the lab experiments will be counted toward the lab component of the course.

Homework (problem sets):

There will be several problem sets assigned and plenty of discussion questions. Do more if you feel like it. Due to popular demand they will not be graded, and some may be done together in group format during class time. Students are encouraged to suggest topics for homework problems!

Quizzes:

There will be quizzes given throughout the term. Most will be take-home and some may be done in class. Each classroom quiz will contain one long or several short questions, intended to be easily finished in 30 minutes. Take home quizzes may occasionally replace or supplement homework sets.

Videos:

The class will watch several short videos from the Annenberg *Physics for the 21st Century* series. Students must watch every video that is assigned, participate in discussions, and turn in a short summary of what they learned in each video. Students who miss the videos in class may watch them in the GRCC library or online.

Exams:

There will be a final exam (take-home or in-class). Since the published final scheduled for this class will most likely conflict with the final scheduled for other courses, the final will not be held during the regularly scheduled time slot published in the schedule. Another time will be announced later.

Attendance:

Due to the small number of class meeting times, missing a class is not a great idea. This course deals with conceptually difficult material. ***Students report that even missing a single discussion can lead to a feeling of being quite lost!*** Still, attendance itself will only be collected for the purposes of the college and will not be used for grading.

Late homework, exams, etc.:

Video summaries must be completed on time. Students will lose 20% of the points for a video summary that is one day late and 50% of the points for a reading guide that is more than one day late.

Problem sets may be turned in up to a week late without losing credit. *You may turn in your homework a few days late, but please don't abuse the privilege.* Students should police their own work and prove to themselves that they can keep up in their studies without threats from the teacher. Due to the sequential nature of the material, students will be required to keep up within one week of the class so assignments must be turned in within a week of the due date.

“Guests” in the classroom:

Due to GRCC policy, no one who is not either registered for the class or an employee of GRCC will be allowed in the classroom during lecture or laboratory periods. This includes children, friends, and prospective students. If a guest appears in our class, it is my understanding that the college will send a group of quantum mechanical lawyers who will simultaneously prosecute and defend the offending student until we all go mad.

Grades:

Grades for this class will be computed from the following five components which will be awarded “class points” approximately as follows:

Course component:	Class points:
Lab experiment	10 points
Video summaries	10 points
Classroom participation	10 points
Homework (roughly 10 problem sets)	25 points
Quizzes	25 points
Final Exam	20 points

So how many points do I need to get an A? To pass?

The instructor reserves the right to modify the grading scheme at any time if he believes it is to the benefit of the class as a whole. In general a total of 96 points or more will earn a grade of 4.00, a total of 76 points will earn a grade of 2.00, and the scale is linear ((points – 56)/10).

Other grades:

A grade of “T” will only be given in emergency situations and only if at least 75% of the work is completed satisfactorily. A grade of “P” can only be given if requested in writing at the registrar’s office before the deadline published in the catalog (students should know that completion of a course with a grade of “P” is *not* considered completion of a prerequisite for another class).

Material Covered:

The list of material below is ambitious and subject to change. Although we plan to spend most of the quarter covering just three chapters from Serway and Jewett, the concepts in those chapters are very difficult. More time will be spent on quantization and particle physics if time allows, but some topics may fall by the wayside as well.

Students are encouraged to suggest different directions and different subjects for our study! Some subjects are hard to study without going through the basics (which are essentially outlined below) but attempts will be made to accommodate the modern physics interests of the students.

Time (approx.):	Subject:	Blatt Chapters
WEEK 1:	Relativity I: meters and seconds again	1
WEEK 2:	Relativity II: vectors again	1
WEEK 3:	Relativity III: dynamics again	2
WEEK 4:	General Relativity	3
WEEK 5:	Sometimes “waves” act like particles	4
WEEK 6:	Quantization	4
WEEK 7:	Atoms and nuclei	5
WEEK 8:	Sometimes “particles” act like waves	6
WEEK 9:	Probability and Wave Functions	7
WEEK 10:	Schrodinger’s Equation	7
WEEK 11:	Particle Physics	just for fun

Material may be added or removed from the schedule as time and interest allow.

Videos from Physics for the 21st Century will be assigned throughout the school term, roughly one per week.

Special needs:

Any student who needs special accommodations because of a disability, needs emergency medical information kept on hand, or requires any other special accommodations to be shared with me in the event of a building evacuation, please contact me at extension 4248. If you need an alternative medium for communicating, or are particularly dependent on any one specific medium, please let me know before class so that appropriate accommodations can be made.

If you believe you qualify for course adaptations or special accommodations under the Americans With Disabilities Act, it is your responsibility to contact the Disabled Students Services Coordinator in the LSC and provide the appropriate documentation. If you have already documented a disability or other condition which would qualify you for special accommodations, or if you have emergency medical information or special needs I should know about, please notify me during the first week of class. You can reach me by phone at 833-9111, extension 4248. Or, you can schedule an office appointment to meet me in the SMT Office Building, office number 323 during my posted office hours or at another mutually determined time. If this location is not convenient for you, we will schedule an alternative place for the meeting. If you use an alternative medium for communicating, let me know well in advance of the meeting (at least one week) so that appropriate accommodations can be arranged.

SYLLABUS QUIZ (Due Thursday)

NAME: _____ (please print)

PHYSICS 225

Instructions: Read the syllabus, answer the questions below, and sign the form at the bottom indicating that you have read the syllabus. Return this to the teacher.

When are the meeting times for Physics 225A?

When are Keith's office hours? Where is his office?

Where will you need to check out supplementary textbooks?

What happens to Physics 225 students who turn in video summaries two days late?

What happens to Physics 225 students who turn in problem sets two days late?

What are the three lab experiments we will do some time this quarter?

When is the deadline for applying for a Pass/Fail grade? (Check the quarterly schedule.)

I have read the syllabus for Physics 225

Signed,

(Signature of student)

(Date)