PHYS 221: General Physics III: Intro to Modern Physics
Spring Semester 2017

Title: General Physics III: Intro to Modern Physics

Content: Quantum Mechanics, Statistical Physics, Atomic Physics, Condensed Matter Physics, Relativity, Nuclear Physics, Particle Physics

Prerequisites: PHYS 116 or PHYS 122 or PHYS 124

Schedule: Lectures: M W F 3:20 to 4:10 PM in Rock 301
Recitations: Th 10:00-10:50 AM in Wickenden 321
or Th 1:00 to 1:50 PM in Bingham 103

Instructors: Philip Taylor (primary instructor)
ROCK 225F Phone: 216-368-4044
E-mail: taylor@case.edu

Robert Halliday (recitations)
A.W.Smith Rooms 10 and 13
E-mail: rph32@case.edu Available through Google Chat

Ryan Chaban (SI) E-mail: rac164@case.edu

Course Web Page: http://www.phys.cwru.edu/~plt/phys221/

Required Text: Modern Physics, 2nd Edition by Randy Harris

Homework: Due weekly on Mondays in class before lecture.
Twelve assignments, lowest two scores will be dropped.
Homework solutions done by instructor, posted Monday on web.
No late homework can be accepted, so please don’t ask.

Workload: Homework (and a few quizzes) 25%
First hour exam (Wed Feb 8) 15%
Second hour exam (Wed Mar 8) 15%
Third hour exam (Wed Apr 12) 15%
Final exam (Tuesday May 9) 30%
### Syllabus:

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<th>Week</th>
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<th>Chapters</th>
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<td>Jan 18</td>
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<td>Waves &amp; Particles</td>
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<td>Jan 23</td>
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<td>Bohr’s Atom</td>
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<td>3</td>
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<td>Feb 6</td>
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<td>Wells &amp; Barriers</td>
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<td>5</td>
<td>Feb 13</td>
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<td>The Hydrogen Atom</td>
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<td>Spin</td>
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<td>7</td>
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<td>Molecules and solids</td>
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<td>10</td>
<td>Mar 27</td>
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<td>Semiconductors, materials</td>
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<td>11</td>
<td>Apr 3</td>
<td>2</td>
<td>Theory of Special Relativity</td>
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<td>12</td>
<td>April 10</td>
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<td>Relativistic energy</td>
<td>3rd Exam: Wed Apr 12</td>
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<td>Apr 17</td>
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<td>Radioactivity, Nuclear Physics</td>
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<td>14</td>
<td>Apr 24</td>
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<td>Particle Physics &amp; Cosmology</td>
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<td>15</td>
<td>May 1</td>
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<td>Review</td>
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<td>May 2, 3</td>
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<td>Reading Period</td>
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<td>May 9</td>
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<td><strong>Final Exam 3:30-6:30 PM</strong></td>
<td>Exam: Tue May 9</td>
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### Lectures:

Lectures are Mondays, Wednesdays, and Fridays from 3:20 to 4:10 PM. I will try to start and end promptly. I request that you do not have laptops open during the lectures.

Although the class is relatively large I would very much like to encourage student participation in the lecture. Please feel very free to raise your hand to ask a question or clarify a point. If you are puzzled, then chances are your fellow students are puzzled too and will be grateful that you asked the question. If you see me doing something obviously wrong on the chalkboard, make a noise or something so I do not get too far before I correct myself (I do not take offense easily!)

### Text:

The required text is *Modern Physics* by Randy Harris (2nd Edition). It is not a great text, but is the best available. A reading assignment will be noted with each homework. In the reading assignment I will try to highlight sections that are important and indicate which sections are less important as well. You will find the lectures *much* more helpful if you have read the assigned text in *advance* of the lectures. You should be prepared for a quiz to test whether you have read the assignment.
Recitation Sections:

Each student in the course should be co-registered for one of two weekly recitation/discussion sections, which meet on Thursdays. The recitation instructor is Robert Halliday, reachable at rph32@case.edu. Participation in the discussion sections is optional, but strongly encouraged.

Supplemental Instruction:

The goal of the SI program is to practice what you learn in class and on your own through collaboration with your peers. You will ask questions, review material, work sample problems, and prepare for exams. Your SI Leader is Ryan Chaban. He has succeeded in the course and has experience helping others do the same. Go to a session, bring your friends. He is looking forward to seeing you!

http://students.case.edu/education/resources/instruction/schedule.html

Homework:

The homework is a very important part of this course, and will count for about 25% of your final grade. You will be given homework on Mondays in lecture (along with a reading assignment for the coming week). The completed problems will be due the following Monday. The homework must be turned in just prior to the beginning of lecture in the appropriate box at the front of the lecture hall. Homework will be graded and returned to you as soon as the graders have been able to finish their work. Homework solutions will be posted on the course web page on the day the assignment is handed in. For this reason, and because the pace of the course is relatively fast, no late homework will be accepted.

How homework will be graded: You will be asked to submit a total of twelve homework assignments during the semester. For your homework grade, we will use the top ten best homework scores for each student and will drop your two lowest scores. I figure that during the semester, a typical student has one personal emergency (gets ill, family crisis, etc.) and one unavoidable academic scheduling conflict (exam, paper) that substantially impacts the ability of the student to complete the homework in a satisfactory way. By throwing out the lowest two homework scores, I account for these problems whatever the reason.

Note: For the week before the spring break, there will be no homework due.

Working with others to get your homework done: You are allowed and encouraged to work together on your homework. Learning from peers is really one of the best ways to learn physics. Just don’t overdo it. You can help each other figure out how to approach each problem, but you must do each problem yourself. Don’t let other people do the work for you. You need to learn to do the problems on your own. It is likely that at least one of the homework problems will appear (in modified form) on each of the exams. It is not acceptable to copy another’s homework, or to allow your homework to be copied by others. Copied homework will result in zero credit assigned to both copier and copiee.
Exams:

Note the dates of the four exams. These will be “closed book” and you will be able to bring a single sheet of 8\(\frac{1}{2}\) x 11 paper with any hand-written notes that you wish on one side of it to the hour exams and three such pages to the final exam. The 50-minute exams will be given in class. The final exam will be three hours long. All exams together count for a total of 75% of your grade.

How to Contact the Primary Instructor:

There are several ways to reach me:

Office location: Rockefeller 225F
Office Phone: (216)-368-4044
Secretary: Lori Morton: (216)-368-4257
E-mail: taylor@case.edu

Instructor’s Office Hours:

I come in to work around 9:30 and I am here until 7 PM most days, and my office door is always open. My formal office hours will be after class on Mondays and Wednesdays, but I have been put on enough committees that I may sometimes not be available at that time. If you have difficulty finding me then e-mail for an appointment, giving a selection of available times.

Grading policies:

I strive for a fair and impartial grading policy. Your grade should reflect the degree to which you have demonstrated mastery of the material and central concepts of the course. The grading will be based strictly on a comparative numerical score tallied at the end of the semester. Your numerical score alone will determine your assigned grade. There is no mechanism for extra credit.

Letter grade assignments will correspond to numerical score ranges. The correspondence between numerical scores and letter grades will depend both upon the distribution of the scores and upon a reasonable expectation for performance in the course.

How are you doing?

I like to keep everybody as fully informed as possible of their standing in the course. At the same time it is important to respect the privacy of those who want to keep their scores to themselves. The scheme I have devised is to make my own spreadsheet available on the web, but with the names disguised. You must find out your code name from me, and then you will be able to learn how you stand with respect to the rest of the class.

Purpose, Philosophy and Goals of the Course

PHYS 221 is the third general physics sequence. In this course we introduce many of the major developments in physics that have taken place during the 20th century – the age of what we call “Modern Physics”. This name is used in contrast to the development that took place prior to the 20th century, which today we call “Classical Physics”. Specifically, Classical Physics refers to the major physical theories of Newton’s mechanics, Maxwell’s
Electromagnetism, and various increasingly sophisticated models describing physical, chemical, and thermodynamic properties of materials and other multi-body systems as understood through the late 1800’s. In fact, by the turn of the century, Classical Physics was so successful at explaining a large range of phenomena with precision, that there was a widespread belief among scientists of the day that perhaps physics as a discipline was nearly complete, with only some details to mop up for the future. They could not have been more mistaken.

With the advent of the 20th century an increasing number of unusual physical phenomena were observed that resisted attempts to find explanations in terms of known Classical physics. Ultimately, a new generation of theoretical physicists developed two completely new and radical theories to describe and account for these odd phenomena: these are (1) Quantum Mechanics and (2) Relativity. As we shall see in this class, these new “paradigms” represent a great sea change in our view of how the physics universe really works at the most fundamental level – a view that is often very contradictory to our everyday intuition of the physical world. Significantly, these new theories and their applications have resulted directly in the development of a wide range of technologies that are intrinsic to our modern society. Furthermore, these new theories have also resulted in radical changes to our understanding of what the universe as a whole is made of, how it was born, and how it is evolving.

Our goals for students in this course will be:

- to understand the fundamental concepts underlying the central theories of modern physics, namely Quantum Mechanics and Relativity,
- to understand how these theories resolve various problems, puzzles, and anomalies that cannot be satisfactorily addressed by classical physics,
- to have a working familiarity with the main consequences of these modern theories – despite the fact that these consequences are often very contradictory to our everyday experiences of the physical world,
- to appreciate how the application of modern physics has led directly to a wide range of critically important technological developments.

Have fun!