Physics 253 Modern Physics   Spring 2003   Dr. Schwalm

Office hours 11:00-12:00 MWF, other times when available. (I am always available by telephone at night, 10:00pm-2:00am in my office, 777-3530. e-mail I may not notice.)

Textbook: either *University Physics*, Seqrs Zemanski and Young, or similar (required)
Textbook: *Perspectives in Modern Physics* Beiser (required)
Prerequisites: Physics 252, 252L, Calculus III
Corequisite: Physics 252L, Modern Physics Laboratory

Class:	**(253)**	**10:00-10:50 MWRF**	**Witmer Hall 115**
Lab:	**(253L)**	**3:00-450 M**	**Witmer Hall 208**

The objective is to learn about the surprising developments in physics during the 20th century, upon which much of modern life depends. In broad categories, this includes the theory of relativity, quantum theory and statistical mechanics. For engineers, chemists and physicists it is not enough to know only disconnected facts and formulas, so the course will concentrate on connections between things. We shall see how to get from one result or formula to another by algebra, or how one thing implies another logically. This is so that you can start at any point in the subject and get to anywhere else with your own hands. In this way the subject will be alive in your head and you will really be able to use it.

The course is an overview of or first introduction to some theories and phenomena that one would study in more detail in upper-level physics courses such as quantum mechanics, solid state physics, nuclear physics, statistical mechanics, etc.

In both the class and the lab, emphasis will also land on how we know what we know. What are the experimental foundations of the physical theories? How does one observe these phenomena of quantum theory, what do they really mean? You will also learn some of the fascinating historical background of some of these 20th century discoveries.

From a practical point of view, what are you supposed to be able to solve physics problems, similar to (but not just the same as) problems worked as examples in lecture or in the text or homework problems. This involves a certain kind of analytical thinking. It is what will determine your grade, and it is also what you are expected to know how to do when you finish the course. It is a reasoning process that you will probably use later on in your work, in various ways. As well as learning how to solve particular problems, you will sometimes be asked to show me the logic in getting from one result or equation to another. This is also a thing you need to study, as you will be graded on it too.

Homework will be assigned at the beginning of each course. I will collect it at the beginning of the next class, grade it and return it to you. As a general rule, I do not accept late homework. However, the system is pretty flexible in the following way. Only you highest 25 scores count toward your final grade. I will grade more like 35 papers during the semester, and so you can easily miss assignments when you need to without affecting your grade. Always do the problems anyway, though, as this is important for learning. Maximum score on any one assignment is 20 points.

Max Homework: (25)(20) = 500 points.

There will be three exams, each worth 100 points. However, only your best two exams count. This means *if you have to miss an exam, this will just be the exam you don't count.* There are no make-up exams. Thus

Max Examinations: (2) (100) = 200 points.

The final will be 8:00 am Monday May 12 in the class room. This will be comprehensive and will count :

Max Final: 150 points

You must be signed up for 253 Lab. The lab grade will count 15% of your final course grade, so

Max Lab: 150 points.

Maximum possible score is 500+200+150+150 = 1000. Final grades will be given as 0-599 F, 600-699 D, 700-799 C, 800-899 B, 900-1000 A

Preliminary list of topics to be covered

1. **Review of electromagnetic waves**
2. **Wave interference and diffraction**
3. **Special relativity**
4. **Qualitative discussion of general relativity**
5. **Particles as waves—waves as particles**
6. **Atomic structure**
7. **Bohr theory of the atom and its modern uses**
8. **The wave function, its meaning and the Schrödinger equation**
9. **Applications of elementary quantum mechanics**
10. **Modern quantum theory of the hydrogen atom**
11. **Quantum theory of angular momentum and spin**
12. **Spin, Bosons, Fermions, exchange symmetry and the exclusion principle**
13. **Atomic spectra**
14. **Chemical bonding**
15. **Statistical mechanics**
16. **Bonding in solids**
17. **Crystal structure**
18. **Band theory of solids**
19. **Quantum statistics**
20. **Specific heat of solids**
21. **Atomic nucleus, fundamental properties**
22. **Shell model and single-particle ground state properties**
23. **Liquid drop model and the mass formula**
24. **Liquid drop and collective excitations, fusion and fission**
25. **Fundamental particles: leptons and quarks, fundamental forces**
26. **Some basic concepts from particle physics**
27. **Nuclear force and the Yukawa meson theory**
28. **Sakata, SU(2) and isospin**
29. **SU(3), quarks and the standard model.**