University of Maryland

Department of Physics, College Park, MD 20742

Physics 402----Quantum Physics II----Spring 2003

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Office Hours

Office hours are immediately following class. I am also generally available in my office and happy to see students; just drop by--or, better yet, give me a call and then drop by.

Course Philosophy

The basic formalism of quantum mechanics was developed in Physics 401. Physics 402 has three main purposes: i) to generalize the basic framework so that we can study problems in three dimensions, problems with spin degrees of freedom and many-body systems. ii) to use quantum mechanics to study physical problems of interest particularly in atomic and solid state physics and iii) to develop approximation methods which allow us study problems which are not tractable for exact solution and which give insight into the underlying physics.

Books

The principal text for the course is Griffiths' *Introduction to Quantum Mechanics.* The book is very readable and clear. One drawback of Griffith' s book is that it is quite concise and leaves out a lot of good physics for the student to work out as problems. I will work out many of these in class.

Homework

Problem sets will be assigned regularly. Problem sets may require the use of numerical analysis that can be done in *Mathematica* or some other computer program. I strongly encourage students to consult each other on problem sets. Ideally you should attempt all

of the problems by yourselves and if you get stuck you should then consult your peers. Homework will count approximately 20% of the final grade.

Exams

There will be a midterm exam and a final exam in this course. The exams will count for approximately 85% of the total course grade. The date of the mid-term exam will be announced in class.

The exams are currently planned as take-home. Take-home exams have two virtues: they reduce the time pressure on students and allow them to perform at their best and they allow for questions that are less trivial than can be done during a class period. They do have a potential drawback, however. They are impossible to police efficiently against cheating. Thus, we must rely on your integrity. I will ask you to pledge to do the exams alone and to stick to this pledge. I should note that the whole enterprise of science depends on the integrity of the researchers--- when I read a scientific paper I must assume that the researchers didn't cook the books or I won't get anywhere.

Honor Pledge

The University of Maryland has instituted an honor pledge. Students are asked to write by hand and then sign the following statement on all significant course work not explicitly exempted by the instructor:

"I pledge on my honor that I have not given or received an unauthorized assistance on this assignment/examination."

For Physics 402, problem sets are from the honor pledge. Indeed, for problem sets, I actively encourage students to collaborate. However, the honor pledge should be taken for exams.

Note that it is not mandatory for students to take this pledge but they are bound by the University's Code of Academic Integrity regardless of whether they take the pledge.

Tentative Course Outline

Quantum Mechanics in Three Dimensions (Chapter 4)

- Generalizing the Hilbert space to add degrees of freedom
- Quantum mechanics three dimensions
- Central force problems and spherical Harmonics

- Angular momentum
- The hydrogen atom
- Spin

Applications of Quantum Mechanics with two or more particles (Chapter 5)

- Generalization to many particles
- Two particle systems and the reduced mass
- Identical particles and exchange symmetry---fermions and bosons
- Aspects of atomic physics---role of the Pauli principle
- Aspects of solid state physics---the fermi gas; Bloch's theorem and band strucutre

Approximation Methods in Quantum Mechanics (Chapters 6-10)

- Time-independent perturbation theory
- Applications of time independent perturbation theory in atomic physics
- Brief treatment of other time independent approximation methods---variational and WKB approximations
- Time-dependent perturbation theory
- Application to two level systems
- The sudden and adiabatic approximations

Scattering theory (Chapter 11 if time permits)

- Meaning of Cross-Section
- Partial wave analysis and phase shifts
- The Born approximation