PHYS 501: QUANTUM PHYSICS I

SYLLABUS — Fall, 2010

Instructor: Kuniharu Kubodera

Office: 516 Main St., Room 111 (until November 2010, when the Physics Department will move back to PSC, 712 Main St.)

After this move, my office will be PSC 702-F.

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Required Text: **"Quantum Mechanics" (Second Edition)** by **D. J. Griffiths**, Prentice Hall, ISBN 0-13-111892-7

Prerequisite: A grade of C or better in PHYS 307 and MATH 242.

Course Description: A self-contained treatment of quantum mechanics and its basic applications, beginning with the Schroedinger equation.

Learning Outcomes:

The students first learn fundamental conceptual differences between classical and quantum physics and then they are guided to understand the fundamental meaning of the Schroedinger equation. They will learn the background and consequences of such revolutionary ideas as the statistical interpretation of wave functions, and the Heisenberg uncertainty principle. The students then will be trained in quantitative treatments of the Schroedinger equation and guided to apply it to several important solvable cases that have wide applications. Starting with the simplest one-dimensional problems, the students will become familiar with the treatment of full 3-dimensional problems, including the quantum mechanical description of angular momentum. The students will obtain a rigorous, quantitative understanding of one of the most important microscopic systems, the hydrogen atom. After learning the spins and the Pauli exclusion principle, the students will be able to grasp physics principles underlying the structure of atoms and the origin of the periodic table.

To supplement the explanation of the Learning Outcomes, we list below in itemized forms the topics to be covered in this course:

Week 1: Linear algebra as a tool for describing quantum mechanics

Week 2-3: The Schroedinger equation, Born's statistical interpretation

Week 4-5: Heisenberg's uncertainty principle,
Time-independent Schroedinger equation

Week 6-7: The harmonic oscillator, One-dimensional problems

Week 8-9: Hilbert space, observables, Dirac notation,
Three-dimensional Schroedinger equations

Week 10-11; Quantum-mechanical treatment of angular momenta,
The hydrogen atom

Week 12-13: Multi-particle systems and symmetric and anti-symmetric states

Week 14: Spin and the Pauli principle

It is assumed that the students are reasonably familiar with basic linear algebra but, since a background knowledge of this subject is very important for understanding quantum mechanics, its essential points will be briefly recapitulated in class. If you need more training in linear algebra, please contact me at an early stage, so that we can discuss possible remedial measures.

Homework, Required Exercises, Exams and Grading:

You are encouraged to solve for yourself as many exercise problems as possible in the textbook. When necessary, I will specify problems to be studied with particular care; these problems, to be called "required exercises", are likely candidates for the mid-term and final exam problems. Furthermore, some of the required exercises will be given as homework assignments. Please observe a deadline for homework.

The final grade is determined by three components —

(1) Cumulative homework grade,

(2) Midterm examination grade,

(3) Final examination grade.

Each of these three components carries the same weight factor of 1/3.

The grading scale is as follows:

A: 90-100, B+: 83-89, B: 76-82, C+: 69-75, C: 60-68, D: 50-59

Extra Requirements for Graduate Students:

Graduate students (as opposed to undergraduate students) are required to solve extra problems in homework and also in the midterm and final exams. These extra tasks will be specified explicitly on each occasion.

Office Hours:

I do not set up formal office hours. Please feel free to come to my office with your questions any time.