PHYS 502: QUANTUM PHYSICS II

SYLLABUS — Spring, 2011

Instructor: Kuniharu Kubodera

Office: PSC (Physical Science Center), Room 702-F

Phone: (803) 777-5274

E-mail: kubodera@sc.edu

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, MATH 242 and PHYS 501.

Course Description:

Advanced subjects in quantum mechanics.

Learning Outcomes:

In PHYS 501 (Quantum Physics I), the students have learned how to solve the Schroedinger equation for a limited class of problems that allow exact solutions. In nature, however, we encounter many cases for which there are no exact solutions, and so it is imperative to develop useful approximate methods to solve the Schroedinger equation. In PHYS 502, the students first learn the principle and applications of a very powerful approximate method called perturbation theory. One of the important branches of this method is called time-independent perturbation theory, and the students will learn how to formulate and use it to determine a stationary-state solution to the Schroedinger equation. Another important branch is time-dependent perturbation theory, which is used to determine the probability of occurrence of a quantum mechanical process under the influence of a small external disturbance. The students will master how to use this method to calculate, for example, the intensity of light emission from an atom. Towards the end of this course, the students learn the introductory part of special relativity.

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

Week 1-4: Time-independent perturbation theory – Non-degenerate cases

Week 1-2: First-order approximation,

Week 3: Second-order approximation

Week 4: Applications

Week 5-8: Time-independent perturbation theory — Degenerate cases

Week 5-6: General treatment

Week 7: Zeeman effects, Larmor precession

Week 8: Further apllications

Week 9: The variational principle

Week 10-12: Time-dependent perturbation theory

Week 10: General consideration

Week 11: The Fermi Golden Rule

Week 12: Applications

Week 13-14: Special relativity

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.