PHY 7400 – Quantum Mechanics I – Syllabus

Semester: Fall 2016

Lecturer:

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Lecture Time/Room:

Lecture **Monday, Wednesday, Friday 12.50-1.45 pm**, 177 Physics Building

Suggested Texts:

S. Weinberg, Lectures on **Quantum Mechanics**, (Cambridge);
J. J. Sakurai, **Modern Quantum Mechanics**, (Addison-Wesley Publ. Company);
L. Landau and E. Lifshits, **Quantum Mechanics**, (Butterworth-Heinemann Ltd).

S. Weinberg's text will be the main textbook for this course.

Office Hours: by appointment.

Grading:

Your course grade will be determined by your performance in homework assignments, a midterm exam and a Final Exam on the basis of the following distribution.

Homework Projects (typically every week)	30%
Preliminary Exam	30%
Final Exam	40%

The completed homework assignments are due at the end of the class on the date specified on the assignment, which is typically one week after the assignment is given. Late submissions will not be accepted.

Course description and objectives:

This course provides an introduction to methods of quantum mechanics, including Schrödinger equation and its solutions as applied to simple physical problems, elementary approximate methods, and scattering theory.

Topics to be covered (approximate):

1. **Physical principles of quantum mechanics.** Wave nature of matter. Davisson-Germer experiment. The wave function. Superposition principle.
2. **Mathematics of quantum mechanics.** Operators and expectation values. Commutators and operator algebra.
3. **The principles of wave mechanics. General properties of the motion of quantum objects.** Schrödinger's equation. Examples of one-dimensional motion.
4. **Matrix formulation of quantum mechanics.** Vector spaces. Bra-Ket notations. Representation theory. The Heisenberg uncertainty relations.
5. **Particles in a central potential. Angular momentum in quantum mechanics.** Spherical harmonics. Spherically symmetric potentials. Addition of angular momenta. The Wigner-Eckart Theorem.
6. **Spin.** Rotations. Bosons and fermions. Inversions: P, C and T.
7. **The WKB approximation.** WKB method. Bohr-Sommerfeld quantization conditions.
8. **Approximate methods I (time-independent).** Variational methods and perturbation theory. The Zeeman and Stark effects.
9. **Approximate methods II (time-dependent).** Monochromatic perturbations. Adiabatic approximation. The Berry phase.

The material discussed in class will approximately correspond to the first six chapters of S. Weinberg's book (**Lectures on Quantum Mechanics)**.

Learning outcomes. After taking this class you will:

1. Learn about the basic phenomena of the quantum world: stationary states, wave packets, tunneling, entanglement, and spin.
2. Become familiar with the basic problems of quantum mechanics for which exact solutions- of the Schrödinger equations are possible.
3. Be able to translate the physical description of a problem into equations that can be used to answer relevant questions.
4. Build skill in the mathematical methods needed for these problems.
5. Recognize when and how to make useful approximations, i.e., which terms in a series expansion are important in a specific physical limit.
6. Recognize when symmetries are useful.

Website: http://www.physics.wayne.edu/~apetrov/PHY7400/

All course material will be posted on the web and can be found at the website above.

Grading:

The overall course grade will be determined on the basis of the following grading curve:

Grade	Cumulated Score	Grade	Cumulated Score
A	90-100	C+	65-69
A-	85-89	C	60-64
B+	80-84	C-	55-59
B	75-79	D+	50-54
B-	70-74	D	40-49

Any score below 40 is considered as F.