Physics 424 Quantum Mechanics
Preliminary Syllabus

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Lecture: Monday - Wednesday - Friday 9:00 – 9:50
Physics Building Room 201

Course Overview: This course is the undergraduate, upper-level quantum mechanics course. You should start the course with an understanding of basic ideas in quantum physics from your modern physics class. In this course we will examine in more detail some of the applications from modern physics. In particular, we will look at the formalism of quantum mechanics and be able to apply quantum mechanics to a larger array of problems and situations. By the end of the semester I expect you to be able to work with the methods that we cover and understand their application to the various systems that we model. By the end of the semester, I expect you to be able to

- Understand the origins and use of the wave function
- Detemine expectation values of operators
- Find values and probabilities of these values for measurements on systems
- Apply raising and lowering operators to appropriate situations
- Apply perturbation theory
- Recognize specific standard situations and their solutions

What the course will cover:

- Historical Origins (see Taylor, and Eisberg & Resnick)
  - Black-body radiation (Stefan-Boltzmann, Rayleigh-Jeans, Planck Laws)
  - Bohr theory of the atom
  - Other wave-particle duality systems
- Basic Concepts
  - Wave properties of matter
  - States of quantum systems
  - Uncertainty principle
- Wave Mechanics
  - Schrödinger equation
  - One-dimensional systems
  - Motion of free particles
  - Statistical interpretation
  - Orthogonality of wave functions
  - Operators
  - Parity
  - State vectors and their representations
  - Commuting operators
  - Creation and annihilation operators
  - Three-dimensional systems

- Multi-Particle Systems and the Pauli Principle
- Angular Momentum in Quantum Mechanics
- Approximation Methods, Perturbation Theory
- Specific Applications
    - Harmonic oscillator
    - Central potentials
    - Hydrogen atom

Since this class is relatively small, it will be a relaxed lecture setting. In other words, although it will be a lecture course, there is ample opportunity for you to ask questions during the lecture. In addition, there are many opportunities for me to ask you questions during the lecture. We will examine some of the homework problems in detail during class, and you will be asked to lead the discussion in these instances.

Pre-requisite: Phys321, Phys324, Math221, Math225, Math251

Textbook: Introduction to Quantum Mechanics by David Griffiths

Other useful textbooks:

Modern Physics by Taylor (your 324 textbook for the intro to quantum mechanics)

Thermal Physics by Schroeder (your 303 textbook for blackbody radiation)

Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and Particles by Eisberg and Resnick (good for all the above and lots of verbiage on the quantum mechanics we will be doing)

Understanding Quantum Physics by Morrison (very detailed book on the 1st part of the course)

Introductory Quantum Mechanics by Liboff (lots more mathematical details)

Many of these are in the Physics Library, please do not remove them so they are available for all.

Grading: There will be three exams during the semester each of these will be worth 20% of your final grade. The final exam will be comprehensive and worth 20% of your final grade. As with all physics courses, homework assignments are an integral part of learning the material, and will be worth 20% of your grade for this class.

Lectures: As I mentioned earlier, we will have a participatory lecture format. You need to re-read the textbook material before each lecture to be prepared; the list of lecture topics is in the schedule on Blackboard.

Homework: This is one of the most important aspects of this class. Although you will learn a lot from my enlightening lectures and from reading the textbook, the only way to learn this material is by working through the important derivations and applying the material to problems. The homework will at times be challenging; remember that it is the only time I can ensure that you examine a complicated problem. There is not enough time for this on exams.

We will start with the homework assigned each week on Wednesday, and collected the next week on Wednesday at the beginning of class. I will not accept late homework. I expect a bit more from you than other instructors may have expected in the past. In particular, I expect there to be a bit of explanation (you know those things called words and diagrams) within your homework solutions. *A point that I want to emphasis is the need to reference any assistance you get with a problem. In particular, if you come across the solution or part of the solution in another book, and you use that to formulate your own solution, please reference it. You will not be penalized for learning how to do something from another source; however, you will be* *penalized for using another source without noting it.* Please do not just copy things down from other sources or your friends. This is a method that ensures you do not learn from the homework and will result in very poor exam grades. Another important issue I want to address is neatness. The solutions must be reasonably clean, neat, and complete. Also, please begin each problem on a new page.

I know that many of you will get together on a regular basis in groups. This is a good tool if used properly and a disaster if used incorrectly. I assume that you will spend around 10 hours per week studying on your own for this class. Once you have done your own studying and worked out the problems, it is good to discuss the ideas with others. Please do not use it without working on the problems on your own. Beware, for I will be asking you to demonstrate solutions to the class. If you cannot show a solution, you will not receive credit for it in the homework.

Office Hours: I am normally available for students, whenever I can be found. However, to ensure that you have an adequate opportunity to see me, my office hours for this class are Monday, Wednesday, and Thursday 1-2. I will be in my office during these hours, and you will have my undivided attention. Please take advantage of these hours if you have any problems with the material.

Academic Integrity: I feel obligated to ensure that students know the repercussions of cheating. If you are found cheating, you will receive a zero for that work. The university has a website that addresses the concept of academic integrity: http://www.umbc.edu/provost/integrity/faculty.html

Preliminary Schedule:

Week	Date	Topic
Week 1	-------	-------
	W Sept 1	Failure of Classical Mechanics
	F Sept 3	Fourier series and Gaussian distributions
Week 2	M Sept 6	**Labor Day**
		Wave functions and their statistics
Week 3		Time-independent Schrodinger equation
Week 4		States and Measurements
Week 5		Harmonic Oscillators
Week 6		**Exam 1**
Week 6/7		Steps, Wells, and Barriers
Week 8		Matrix Mechanics
Week 9		**Exam 2**
Week 9		Central Potentials
Week 10		Angular Momentum
Week 11		Hydrogen Atom
Week 12		Spin and **L·S**
Week 13		**Exam 3**
Week 13/14		Identical Particles
	Nov 25-26	**Thanksgiving Break**
Week 15		Perturbation Theory
Week 16	F Dec 17	**Final Exam (8-10 am)**