Spring 2013 Syllabus

# PHYS 424, Quantum Mechanics

Instructor: Dr. Todd Pittman
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Office Hours: Wed. 9:30-11:00am

Lectures: MWF 11:00-11:50
Location: Physics 201

Course Text: *Introduction to Quantum Mechanics* (2nd edition), by David J. Griffiths

## Course introduction

Welcome to Quantum mechanics, the coolest subject in all of physics! We're in for a wild ride this semester. As Griffiths states in the preface of our text, "*…...quantum mechanics is not something that flows smoothly and naturally from earlier theories. On the contrary, it represents an abrupt and revolutionary departure from classical ideas, calling forth a wholly new and radically counterintuitive way of thinking about the world*."

This course aims to provide an introduction to the *basic ideas* and the *actual mechanics* of quantum mechanics. Through lectures, discussions, and homework problems, I'd like to help you learn how to use quantum mechanics to solve a variety of interesting problems, as well develop some insight into what the solutions really mean. The objective is to build a solid foundation and provide motivation for further study and research in this area.

Quantum mechanics is more important today than ever. Recent advances in technology and laboratory techniques are allowing researchers unprecedented control over the tiny and delicate systems that obey the laws of quantum mechanics, rather than classical physics. This is particularly important in the new field of quantum information processing, which is my own area of research. There are many advances and discoveries to be made….join in!

## Learning outcomes assessment

There are a number of specific educational objectives for physics students at UMBC. The two specific educational objectives that will be assessed in 424 are:

1. A thorough knowledge of the basic fields of physics, such as mechanics, electricity and magnetism, thermal physics, modern physics, and quantum mechanics.
2. The ability to formulate physical problems in the language of mathematics and to use both mathematical and computational skills to solve physical problems.

These objectives will be assessed by my observations of your participation in class discussions, as well as your performance on homework problem sets and written exams.

**Course Schedule (*tentative*)**

| Date | Topic | Griffiths Chapter |
|---|---|---|
| | Failure of classical mechanics; Postulates of QM; brief intro to quantum information | NA |
| | The wave function | 1 |
| | Time independent Schrodinger eq. | 2 |
| Fri. Mar. 1 | **EXAM 1** | |
| | Formalism of QM | 3 |
| | QM in 3 dimensions | 4 |
| Mar. 18-22 | **Spring Break** | |
| | Identical particles | 5 |
| Fri. Apr. 12 | **EXAM 2** | |
| | Time-independent perturbation theory | 6 |
| | EPR paradox; quantum computing | 12 |
| Mon. May 13 | **FINAL EXAM** (last day of class) | |

**Course Grading**

| | |
|---|---|
| Homework/Quizzes | 25% |
| Exam 1 | 25% |
| Exam 2 | 25% |
| Final Exam | 25% |

*Homework/Quizzes*

We'll have homework assignments roughly 2 or 3 times per month. Understanding the homework problems is a key part of your learning QM, and significant portions of the exams will be along the lines of the homework problems. Homework will be turned in at the beginning of the class in which it is due. I cannot accept late homework, since we will discuss solutions in class. There will be brief (5-10 min) in-class closed book quiz for each homework set. The quiz score will count towards the overall homework set score.

*Each graded homework problem will be scored as follows:*

| | |
|---|---|
| 2 points: | Clear explanation with nice derivations, with correct/almost-correct results; quality plots and figures when applicable. |
| 1 point: | Correct results but poor explanation/derivation; Good effort, but incorrect/missing results. |
| 0 points: | Incoherent ramblings; sloppy and un-readable; no effort. |

*Exams*

Exam 1 and Exam 2 will be standard closed-book in-class exams. Exam 2 will be based on the material covered since Exam 1. The Final Exam will also be a closed-book in-class exam; it will be a comprehensive exam covering material from the entire course, with a slightly heavier emphasis on the material since Exam 2.

**Academic Integrity**

As with all courses, Academic Integrity is required in PHYS 424:

*By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Directory.*