Physics 372 Modern Physics II
Spring 2006 Syllabus (Quantum Mechanics)

Instructor	Office	Phone	Email
Eric Wells	GSC 208	274-4913	eric.wells@augie.edu

Text: David J. Griffiths, *Introduction to Quantum Mechanics*, 2nd Ed. Pearson/Prentice Hall

Lectures: MWF, 9:00-9:50 AM, GSC 210

Office Hours: Scheduled office hours are on Monday, Wednesday, and Friday from 8:00-9:00 AM and Monday and Wednesday from 2:00-3:00 PM. Other times are available by appointment. My schedule is posted on the door of my office, and you know how to find me.

Topics: An investigation of Quantum Theory, in which a particle's behavior is described through a statistically-interpreted wave function rather than through the concepts of Newtonian mechanics. Specific topics include an examination of the conceptual framework, solution of the Schrödinger Equation for systems such as the harmonic oscillator and the hydrogen atom and approximation methods for treating more complex systems and the interaction of radiation with matter.

Learning Outcomes: The desired outcome of this course is that students will be prepared to take a graduate level course in quantum mechanics and/or quantum chemistry. By the end of the course, students should be familiar with the formalism of quantum mechanics including Hilbert Space and the Dirac Notation and ready to proceed with a more advanced treatment, *e.g.* those found in the texts by Shankar, Cohen-Tannoudji, or Messiah. Students should also be familiar with the approximation schemes used to treat basic problems, including variational approaches, WKB methods, and time-independent perturbation theory.

Reading: For those of you familiar with Griffiths' Electrodynamics text, this book will have a familiar style. Griffiths takes a conversational approach, and this helps (I think) ease the student through the dense mathematics that sometimes permeates Quantum Mechanics. Some critics complain that the lack of mathematical formalism contained in this text is a drawback – I think the readability more than makes up for this. If you want a more mathematical treatment, there are several books available on the advanced undergraduate level, notably the text by Liboff. I have other texts in my office; feel free to see me about them. Much important material is relegated to the problems in Griffiths' book, so even if I don't assign a problem, it is important to read it. As a general rule, it is desirable to have read the corresponding section in the text before coming to lecture.

Tentative Schedule: We will start at the beginning and assume little background. Since everyone has had PHYS 371 or CHEM 302 or a roughly equivalent course at another school, we will, however, proceed rather rapidly through chapters one and two. We will not have time to cover the entire book, so while we will cover the first four chapters in detail, I will select topics after that point. Time permitting; we will do a project involving molecular modeling techniques.

Midterm Exam: There are tentatively going to be two midterm exams, which may consist of a mixture of take-home and in-class problems. More details will be forthcoming as the semester progresses.

Final Exam: The final exam is scheduled for Thursday, May 18, at 1:00 PM. This exam will cover material from the entire semester.

Homework: Weekly assignments will be given and you can expect them to be challenging. If you start your homework on the day it is due, it is quite likely that you will not be able to complete the assignment. You should make an effort to provide neat well reasoned homework solutions. If an answer is wrong and you know it is wrong and can point out why, I will give this some consideration in grading. If your work is poorly organized and hard to follow or read, I will not be inclined to give much credit for the answer. Some assignments will require the use of

numerical computational techniques. The best way to do well in the course will be to work diligently at the assigned problems. The molecular modeling project will be included in the homework portion of the course grade.

Grading: Semester grades will be weighted as follows:

Midterm Exams	2 x 20% = 40%
Final Exam	25%
Homework	35%

Semester Grades will be assigned on a fixed scale, so there is no need to feel like you are competing against each other. If the class average is particularly low I reserve the right to adjust grades to be higher than the scale given below, but I will not adjust your grade to be lower.

Grade	Percentage	Grade	Percentage	Grade	Percentage	Grade	Percentage
A+	100-96	B+	87-86	C+	77-76	D+	67-66
A	95-91	B	85-80	C	75-70	D	65-60
A-	88-91	B-	79-78	C-	69-68	D-	59-58

Regular class attendance is expected. More than three unexcused absences will mean we need to visit and your grade will be affected.

Exceptions to Deadlines: The will be no exceptions to deadlines on homework for planned absences due to extracurricular activities. The assignments should be completed prior to the absence. Please contact me before a planned absence so that arrangements can be made. If no arrangements are made and an assignment or exam is missed, a grade of zero will be recorded. Deadlines will be extended in extreme cases, such as serious illness or a family emergency. Please notify me as soon as possible in such circumstances.

Academic Honesty: Collaborative work on homework in this class is encouraged. Working with one another on problem sets enhances learning for all involved. If you do work together, please note who you worked with on your paper. Each student is required to turn in separate homework results. Exceptions to this policy (e.g. a group project or a take-home portion of a test) will be clearly noted by the instructor during class. Plagiarism (as defined in the College Catalog) or cheating on exams are serious offenses and will be dealt with harshly. If you are caught cheating or plagiarizing in any form, you will receive a failing grade for the course and be reported to the college for appropriate disciplinary action.

Disabilities and Special Needs: Augustana College strives to assure there is accessibility to activities and programs for students with disabilities. Any students with disabilities who need reasonable accommodation in this course are encouraged to speak with the instructor as soon as possible. It is the students responsibility to inform the Susan Bies in the Disabilities Office (MC 140, Phone: 274-5503) of special needs.

Final Words: Please come and see me about any questions or concerns you have. Sooner is almost always better than later.

Tentative Schedule for Physics 372 – Modern Physics II (Quantum Mechanics)

Date		Topic	Text Section
February	6	Introduction / Schrödinger Equation and the Statistical Interpretation	1.1-1.2
	8	Probability & Normalization	1.3-1.4
	10	Momentum & Uncertainty Principle	1.5-1.6
	13	Stationary States	2.1
	15	Infinite Square Well	2.2
	17	Harmonic Oscillator I	2.3
	20	Harmonic Oscillator II	2.3
	22	Free Particle I	2.4
	24	Free Particle II and the Delta Function	2.4-2.5
	27	Reflection and Transmission	2.5
March	1	Finite Square Well	2.6
	3	**Quiz 1**	**Chapters 1 and 2**
	6	Linear Algebra	Appendix
	8	Hilbert Space	3.1
	10	Observables and Hermitian Operators	3.2
	13	Eigenfunctions of a Hermitian Operator	3.3
	15	Generalized Statistical Interpretation	3.4
	17	The Uncertainty Principle	3.5
	20	Dirac Notation	3.6
	22	Three Dimensional Schrödinger Equation	4.1
	24	Hydrogen Atom I	4.2
April	3	Hydrogen Atom II	4.2
	5	Angular Momentum	4.3
	7	Angular Momentum and Spin	4.3-4.4
	10	Pauli Spin Matrices	4.4
	12	Stern-Gerlach	4.4
	19	**Quiz II**	**Chapters 3 and 4**
	21	Identical Particles	5.1
	24	Atoms	5.2-5.3
	26	Time-Independent Perturbation Theory	6.1
	28	Degenerate Perturbation Theory	6.2
May	1	The Variational Principle	7.1
	3	Helium	7.2
	5	H_2^+	7.3
	8	WKB Approximation	8.1
	10	Tunneling	8.2
	12	Entanglement	Afterword
	18	**Final Exam (1 PM)**	**Comprehensive**