**PHYSICS 346: Quantum Mechanics Fall 2011**

**Instructor:** Dr. Sarah Yost
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**Office Hours:** I will be in my office before class. Office hour times are 9:30–10:30 AM by default, but I will usually arrive on campus by 9.
Please just drop by, I'm almost always in. NB: I supervise labs days 1&2: 5–9 PM and teach at 1:00 on 2-4-6

## 1. Course Information

**Meetings:** 11:20 -12:30 1-3-5, 167 PENGL
**Textbook:** *Introduction to Quantum Mechanics (2nd Ed)*, D. Griffiths
**Websites:** http://www.physics.csbsju.edu/∼syost/346p1112/index.html
*For syllabus and reminders. The communication method for solutions, etc, is via e-mail*

## 2. Introduction

Why do we study quantum mechanics? It's not only to know about the physics governing interactions at teeny-tiny scales, *understanding results at small scales enables us to understand and predict results at "everyday" scales as well.* Allowed energies for atoms and molecules and the rules about transitioning from one quantum state to another explain the locations and strengths of spectral lines. The required properties of quantum wavefunctions lead to observed properties of solids, semiconductors, superfluids and the like.

You were introduced to quantum physics in your modern physics course; this semester we have the opportunity to review and broaden your knowledge of our old friend the wavefunction. We will follow the lead of *Griffiths* to put it through its paces.

The wavefunction is an odd thing, its weirdness all too easily ignored in order to use it to calculate properties of particles and particle systems. *Griffiths* makes sure to point out at the outset the strange thing measurement becomes with the standard interpretation of quantum mechanics. After working with a wide set of techniques, applications and approximation methods to get at the wavefunction and its observable properties, the book finally returns to the argument about whether the system has the measured property before the measurement (answer: no - the universe really is that weird).

Time will not always allow us to go into a great deal of depth in all the topics presented. However, you should end the semester with a much greater understanding of the power and applications of quantum mechanics. You will also have learned to use some approximation methods that extend the applicability of simple quantum calculations to more complex situations. These are the beginnings of the types of calculations that scientists develop to model full quantum systems.

## 3. Feedback: The Student Liaison

This class will have a student course liaison to facilitate feedback about the course, instructor, methods, etc. Any student having trouble with an aspect of the class can go to the liaison if they would rather not come to me directly. I will assume that anything the liaison tells me could be from any student - not necessarily the liaison.

I encourage any student to come talk about aspects of the class which aren't working well for them! The liaison doesn't replace that option; it is an attempt to solicit more meaningful feedback than has been typical in physics courses.

**4. Approximate Course Schedule**

**Mod A:** Wavefunctions, 1D time-independent Schrodinger equation, linear algebra review: Ch 1, Ch 2, Appendix A
**Mod B:** Formalism, 3D Quantum Mechanics: Ch 3, 4
**Mod C:** Identical Particles, Time-independent perturbation theory, intro to approximation methods (variational principle): Ch 5, 6, 7
**Mod D** should introduce the WKB approximation method (Ch 8), time-dependent perturbation theory (Ch 9), and scattering (Ch 11). Also the EPR paradox (12.1, 12.2) demonstrating that nature is "nonlocal", a result Einstein considered preposterous

**Tests:** Will be after Appendix A, Ch 4, and Ch 6. Precise dates TBD.

**5. Assessments**

**In-class activities:** Expect one every class. These cannot be made up or excused. Graded on whether or not satisfactory understanding / serious attempt to complete the problem is demonstrated: **5%**

**Homework:** You are encouraged to work together on the homework but you must write up and understand your own solutions to the problems.: **20%**
Expect homework to be assigned every class, due 1 or 2 class meetings later. Solutions will then be promptly released (emailed as PDFs).
Late work incurs a penalty and homework cannot be accepted at all once the solutions are released. Any arrangements for late work must therefore be made with me before the due date.
Of course, homework will be excused for serious reasons.

**Tests:** 3 in-class tests.: **3x15%**
For each, you can bring a single-sided sheet on which you have written relevant formulas and physical constants. **No worked out problems or examples (showing steps) are allowed.**

**Final Exam:** As set by the registrar: 6–8 PM, Dec 19: **30%**
Comprehensive. You may bring a double-sided formula sheet, as for the tests

**Anticipated Grade Scale:** A $\geq$ 90 B $\geq$ 80 C $\geq$ 65 D $>$ 50 (F $\leq$ 50)
(intermediate grades will be used, but are not set without seeing student results)

## Academic Honesty

CSBSJU's academic catalog defines plagiarism as *...the act of appropriating and using the ideas, writings, or works of original expressions of another person as one's own without giving credit to the person who created the work.* If suspected, the burden of proof rests with the faculty. If proven, the consequence for a first offense is failure of the course.

Again, please note that it is quite helpful to work in groups at times to solve homework problems, and this collective effort is **not** plagiarism. You may be asked to explain something, however, and you must find a way to say it in *your own words.* This is particularly true of ALL homework explanations.

**Any unauthorized use of solution guides (particularly "Instructor's Guides") constitutes academic dishonesty. Presenting work assisted by such items is plagiarism.**

**6. Homework Format**

Quantum physics is decidedly "odd", and it's important to learn what concepts apply to which situations and why. Therefore, unless indicated otherwise, homework answers must start with an explanation **in your own words**.

EVERY homework question that isn't marked "no explanation required" must clearly include what the basic concept / idea is, why you select equations to use, and why you do substitutions, set equations equal to each other, or set something to zero. Algebra, calculus and mathematical simplification do not require explanations.

**I neither want nor expect essays.** Annotations / pointform are good. Remember that you are making these notes for your own review later.

The explanation is ordinarily worth **3 points out of a 10pt scale**.

Due to time constraints, these full explanations will NEVER be expected on tests and quizzes.

Apart from including explanations, homework sets must:
1. Have all the mathematical work required to show how you arrived at the answer
2. Be legible and organized. This includes having no more than two problems per page *(and that would be very short problems! most require at least one page side to show all the work)*
3. Be SECURED together (passing the "shake test")

Many homework questions will be due the day of the next class meeting. Longer sets would eb due in two class meetings. **In either case, working the homework before the next class meeting is essential as the next topic will often build on a previous one.**