

Univ. of Winnipeg Dept. of Physics  
Fall/Winter 2013-14

## PHYS-4601 Quantum Mechanics II

Lecture Times: TTh 11:30AM-12:45PM

Room: 3M56

Instructor: Dr. Andrew Frey

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Office: 2L26

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WWW: <http://ion.uwinnipeg.ca/~afrey/FW1314/qm2/>

Office Hours: M 1:30-2:30PM or by appointment

### Course Description

This advanced course covers the basic theory and applications of quantum mechanics at a more detailed level than PHYS-3301.

### Textbooks

There is one required text, but several others may be helpful.

- **Required:** *Introduction to Quantum Mechanics* by D. Griffiths, 2nd ed.
- **Supplementary:** *Principles of Quantum Mechanics* by Ohanian
- **Supplementary:** *Principles of Quantum Mechanics* by Shankar, 2nd ed
- **Supplementary:** *Quantum Mechanics* by Scherrer

In addition, some extra reading (from other texts, journal articles, etc) may be assigned.

### Topics

We will discuss

- Formalism and Postulates of Quantum Mechanics: — Linear Algebra, Dirac Notation, & States — Operators, Observables, & Uncertainty — Schrödinger Equation & Stationary States
- 1D Quantum Mechanics: — Free Particle — Delta Function — Square Well — Harmonic Oscillator
- 3D Quantum Mechanics: — Angular Momentum — Spin — Hydrogen Atom
- Particle Statistics & Statistical Mechanics
- Interpretation of Quantum Mechanics
- Solid State Physics: — Fermi Energy — Band Structure
- Perturbative Approximations: — Formalism — Applications to Hydrogen — Time-Dependent Perturbation Theory — Scattering & the Born Approximation
- Nonperturbative Approximations: — Variational Principle & Atomic/Molecular Physics — Semi-classical Approximation & Tunneling — Adiabatic Approximation
- Advanced Topics: — Path Integrals — Dirac Equation — Quantum Electrodynamics

Not all topics above will be covered equally. Also, some topics may be skipped due to time constraints.

### Assignment Policies

**Reading:** Reading assignments will be posted on the course web page each week. You are responsible for keeping up with the reading; material covered in the reading will not necessarily be discussed in the class lectures but may be included in tests.

**Homework:** Assignments will be posted on the course web page (see above) in PDF format each Thursday before class. They will **NOT** be handed out in class, so you must tell me if you cannot access the assignments! One student will be assigned to discuss each problem the following Tuesday for a few minutes. The assignment

will then be due the following Thursday at 11:59PM in the labeled dropbox outside room 2L26; make sure to mark your paper with your name and “QMII.” Homework solutions will be posted on the course web page as soon as possible after the homework is due. Collaboration on the problems is allowed, but each student must write up the solutions independently. Late assignments will **not** be accepted without prior permission from the instructor. Some assignments will require the use of Maple software, which is available on the computers in room 2L14.

**Exams:** No electronic equipment is allowed during either in-class tests or the final exam, except at the discretion of the instructor. Students should be prepared to present identification at tests and exams.

**Organization:** Your homework and exam solutions should be written (or typed) neatly with steps explained *as if you were writing a research paper*. Not all algebra need be shown if the steps are explained in words; however, showing your work may improve your credit if you make a mistake. Homework that is not neatly organized and written will not be graded and will be given **zero credit** (one warning will be allowed). In addition, multiple pages must be stapled together.

**Regrading:** If you feel that there is a mistake in grading, I will regrade each problem in question completely. It is possible that newly discovered mistakes will reduce your credit. Please also see the section on appeals.

## Evaluation

**Grades:** Grades will be comprised of the following components:

- Homework Assignments: 47%
- Class Participation (see below): 5%
- 2 In-Class Tests: 13% each
- Final Exam: 22%

**Participation:** The participation grade will be based solely on presentations of homework problems during the Tuesday class meeting following the assignment of homework. If a student is prepared to discuss the assigned problem (that is, demonstrates that he/she has thought about the problem), then the student will receive full credit for that presentation. Otherwise, the student will receive no credit for that presentation. Presenting students are encouraged to take advantage of office hours for advice on the problems.

**Exam & Other Important Dates:** Dates to note include

- First In-Class Test: late Oct/early Nov, 2013
- No TTh lectures: Nov 28, 2013 to Jan 3, 2014
- Voluntary Withdrawal Date: Jan 21, 2014
- Second In-Class Test: late Jan/early Feb, 2014
- Reading Week: Feb 17-22, 2014
- Final Course Lecture April 3, 2014
- Final Exam: Apr 17, 2014, 9AM  
(subject to university scheduling)

## Miscellaneous

**Appeals and Misconduct:** See the **Academic Regulations and Policies** section of the **Course Calendar** regarding appeals and academic misconduct. The minimum penalty for **cheating** on any course work will be a failing course grade.

**Services for Students with Disabilities:** Students with documented disabilities, temporary or chronic medical conditions requiring academic accommodations for tests/exams (e.g., private space) or during lectures/laboratories (e.g., access to volunteer note-takers) are encouraged to contact Accessibility Services (AS) at 786-9771 or email [accessibilityservices@uwinnipeg.ca](mailto:accessibilityservices@uwinnipeg.ca) to discuss appropriate options. Specific information about AS is available on-line at <http://www.uwinnipeg.ca/accessibility>. All information about a student's disability or medical condition remains confidential.

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