Univ. of Winnipeg Dept. of Physics
Fall/Winter 2014-15

PHYS-4601 Quantum Mechanics II

Lecture Times: TTh 8:30-9:45AM Room: 3C14

Instructor: Dr. Andrew Frey E-mail: a.frey@uwinnipeg.ca
Office: 2L26 Office Phone: 786-9215
WWW: `http://ion.uwinnipeg.ca/~afrey/FW1415/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
- Intrepretation of Quantum Mechanics & Quantum Computing
- 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 added, skipped due to time constraints, or taught in different orders.

Assignment Policies

Reading: Reading assignments will be posted on the course web page each week (usually 1-3 sections per 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.

Appeals and Misconduct: See the **Regulations and Policies** section of the **Academic Calendar** regarding appeals and academic misconduct. Note that use of solutions from other courses, previous years, or from the textbook publisher will be considered cheating.

Exam & Other Important Dates: Dates to note include

- First In-Class Test: late Oct/early Nov, 2014
- Remembrance Day Holiday: Nov 11, 2014
- No TTh lectures: Nov 28, 2014 to Jan 5, 2015
- Voluntary Withdrawal Date: Jan 21, 2015
- Second In-Class Test: late Jan/early Feb, 2015
- Reading Week: Feb 16-21, 2015
- Final Course Lecture April 2, 2015
- Final Exam: Apr 22, 2015, 1:30-4:30PM (subject to university scheduling)

Miscellaneous

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., note-takers) are encouraged to contact Accessibility Services (AS) at 786-9771 or accessibilityservices@uwinnipeg.ca to discuss appropriate options. All information about a students disability or medical condition remains confidential. `http://www.uwinnipeg.ca/accessibility`.

Students who plan to conduct research interviews, focus groups, surveys, or any other method of collecting data from any person, even a family member, must obtain the approval of the appropriate ethics committee before commencing data collection. Exceptions are research activities in class as a learning exercise. See `http://www.uwinnipeg.ca/research/human-ethics.html` for submission requirements and deadlines.

All students, faculty and staff have the right to participate, learn and work in an environment that is free of harassment and discrimination. The UW Respectful Working and Learning Environment Policy may be found online at `www.uwinnipeg.ca/respect`.

UWinnipeg promotes a scent-free environment. Please be respectful of the needs of classmates and the instructor by avoiding the use of scented products while attending lectures. Exposure to perfumes and other scented products (such as lotion)can trigger serious health reactions in persons with asthma, allergies, migraines or chemical sensitivities.