PHYS 234: Quantum Physics 1

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Lectures and Tutorials:
Lecture M,W,F 10:30-11:20 am PHY 145
Tutorial will be held in three sessions 3:30-4:20 pm or F 11:30-12:20 pm. The assignment of students to tutorial groups will be completed during the first week. Please look out for special announcements.

Office hours:
M 12:00-1:00 pm (QNC 4129)
Additional office hours can be arranged on request. Any change of office hours will be made known on the LEARN system.

Teaching Assistants:
Matthew Graydon
Feiruo Shen
Will Stacey
Teaching assistants can be reached using the mail function of the LEARN website. They will set up office hours that will be made known on the announcement boards of the LEARN system.

Textbook:
Required text:
- David McIntyre
  Paradigms in Physics: Quantum Mechanics
  Addison-Wesley
  (Note: a special version of this text book containing only the relevant chapters of that book is available at the UW bookstore)

Recommended auxiliary textbooks:
- B. Schumacher, M. Westmoreland
  Quantum Processes, Systems, and Information
  Cambridge University Press (2010) [about 80 CAD]
- N. Zettili
  Quantum Mechanics, Concepts and Applications
  Wiley
- A. P. French and E. F. Taylor
  An Introduction to Quantum Physics
  Norton & co
- J. S. Townsend
  A Modern Approach to Quantum Mechanics
In addition, there are many other textbooks on Quantum Physics and I would advise students to take a look at as many as possible as they all deal with topics slightly differently. An explanation that resonates with one person may not resonate with another, so the usefulness of reading about the same material presented in a variety of formats cannot be overstated.

**LEARN Website**
We will be using the LEARN website to make material for the lectures available, including assignments and handwritten lecture notes.

Announcements will be made via the LEARN system as online notification, but also as emails. Please remember to initialize the forwarding mechanism in LEARN so that all email notifications reach you even if you are not logged into the system.

**Clicker:**
The lectures will make use of clickers, so each student is required to have an iclicker in his/her possession. Participation in the use of clicker questions will count towards the final grade.

Clicker points are based on at least one use per lecture involving clicker questions. In order to avoid issues with absences and misplaced clickers, the clicker participation will be calculated based on 90% of the lecturers using clicker events.

Clickers need to be registered for this course. It is in violation of academic integrity to activate a clicker during lectures that is registered to a different student, especially if that student is not present.

To register your clicker, please go to the website [http://www.student.cs.uwaterloo.ca/~pkates/uw-clicker.html](http://www.student.cs.uwaterloo.ca/~pkates/uw-clicker.html) and follow the instructions.

**Tutorials:**
Tutorials will be held as small tutorial groups (ca 20 students/group). Solutions to assignments will be discussed and marked assignments will be returned. Assistance will also be provided with any question you may have with the material covered in the lectures.
Assignments:
Assignment questions will be issued weekly Wednesdays.
Hand-in time: Wednesdays 10:30 am (before lectures)
Hand-in location: lecture hall PHY 145

For assignments, not necessarily all questions handed out will be graded.

Please Note: No late assignments will be accepted for credit without prior consultation with the course instructor.

Examinations:
– Midterm is scheduled for Thursday, March 6, 7-9:30 pm.
– Final Exam will be scheduled by Registrar’s Office.
In both cases, further details will be provided closer to date.
Please Note: Student travel plans are not considered acceptable grounds for granting an alternative examination time. (see http://www.registrar.uwaterloo.ca/exams/finalexams.html)

Grading: The instructor will choose the best of
– 20% Assignments, 5% Clicker Participation, 30% Midterm, 45% Final Exam
– 20% Assignments, 5% Clicker Participation, 20% Midterm, 55% Final Exam

Minimum Grades for Assignment:
If less than 50% of the total number of assignment points are reached, then the assignment grade will be set to 0% for the calculation of the final grade.

Important Dates (Winter 2013):
Jan 7      - Lectures begin
Jan 24     - Drop, no penalty period ends
Feb 17-21  – University Reading week (no lectures)
Feb 21     – last day for 50 percent tuition refund
Mar 6      - MIDTERM
Mar 21     – Drop, penalty 1 period ends
             (last day to receive WD grade for withdrawing)
Apr 4      - Lectures end
Apr 7      - Drop, penalty 2 period ends
             (last day to receive WF grade)
Apr 8-24   - Examination Period

Verification of Illness
In order to request accommodation due to illness, students will have to file a Verification of Illness form with the Science Undergraduate office. Based on this filing, and an explicit request from the student, the Lecturer will decide how and if an accommodation will be made. Note that usually no accommodation for clicker participation or missing assignments based on illness will be made.
Science students should be aware that starting with the Winter 2013 term, the only Verification of Illness forms (VIFs) that instructors will accept for accommodation for missed assessments (labs, quizzes, midterms, final exams, etc.) will be those issued by the University of Waterloo’s Health Services, when this service is open https://uwaterloo.ca/health-services/. VIFs issued by walk-in clinics will not be accepted, except when obtaining a VIF from Health Services is not possible. If a student is sick on a weekend, during off-hours, while out of town or receiving ongoing care from a family physician or specialist, it is acceptable to provide documentation from other health service providers. Information should include (1) date of the physician assessment, (2) dates of illness, (3) level of incapacitation and (4) whether the diagnosis was made by the physician or based on description by the student.

Keeping the playing field level for all of our students is a priority. Students are reminded that obtaining a VIF under false pretences is an academic offense. For tests and exams, a student found guilty of misrepresentation will receive a failing grade in the course and be suspended.

Any questions concerning this policy can be directed to an undergraduate advisor in the Science Undergraduate Office.
Office: ESC 253 (Monday: 9:30 am - 12:00 pm, 1:00 pm to 4:15 pm Tuesday-Friday: 8:30 am - 12:00 pm, 1:00 pm to 4:15 pm)
Email: current@science.uwaterloo.ca
Phone: 519-888-4567 extension 35244
Web: https://uwaterloo.ca/science/current-undergraduate-students

**Academic Integrity:**
In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]
**Grievance:**
A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, [www.adm.uwaterloo.ca/infosec/Policies/policy70.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm). When in doubt please be certain to contact the department’s administrative assistant who will provide further assistance.

**Discipline:**
A student is expected to know what constitutes academic integrity [check [www.uwaterloo.ca/academicintegrity/](http://www.uwaterloo.ca/academicintegrity/)] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, [www.adm.uwaterloo.ca/infosec/Policies/policy71.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm). For typical penalties check Guidelines for the Assessment of Penalties, [www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm](http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm).

**Appeals:**
A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm).

**Note for Students with Disabilities:**
The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.
Part I: Particles and Waves, Wave-Particle Dualism
   1. Wave-particle duality
      1.1 The classical concept of particles and waves
      1.2 Challenges to the wave picture: light waves can show particle features
         (Photo-electric Effect, Compton Effect)
      1.3 Challenges: wave properties of particles
         (De Broglie Wave Hypothesis, Davisson-Germer Experiment)
      1.4 Young Double-Slit Experiment

Part II: Basic Formalism of Quantum Mechanics
   2. Stern Gerlach Experiment
   3. Quantum Mechanical Postulates and Formalism
   4. Operators in Quantum Mechanics (expectation values, Heisenberg Uncertainty
      Principle, unitary operators, projection operators, spectral decomposition)
   5. Dynamics: Schrödinger Equation and time evolution

Part III: Quantum Mechanics of continuous systems
   6. Continuous Systems
   7. Particles in one-dimensional potentials
      (Infinite potential well, Finite Depth potential well (bound states), Bound states
      in Step Potential, Potential Step, Probability Flux and Scattering Experiments,
      Potential Barrier)
   8. Harmonic oscillator