

CONTACT INFORMATION:

- **Instructor**
Prof. Kazi Rajibul Islam (krislam@uwaterloo.ca)
- **Teaching Assistants**
Daniel Lozano Gomez (dlozanog@uwaterloo.ca)
Mai Sakuragi (MSAKURAG@uwaterloo.ca)
- **Format**
We expect the course to be primarily in-person after the first two weeks in January. However, due to the ongoing pandemic uncertainty, we may expect additional disruptions. The online classes will have synchronous activities.
- **Contact preferences**
Q&A on Piazza
Office hours and online interactions (schedule will be announced on learn)
Email (MUST include PHYS 234 (W22) in the subject line). Email policy – the instructor will attempt to respond to your queries within 2 working days.

COURSE DESCRIPTION:

PHYS 234 LEC, TUT 0.50

Course ID: 007407

Quantum Physics 1

Background of quantum physics. Introduction to formalism of quantum physics. Introduction to operators. Quantization, waves and particles. The uncertainty principle. The Schroedinger equation for one-dimensional problems: bound states in square wells. Harmonic oscillator; transmission through barriers.

*[Note: PHYS 236 or knowledge of computational methods is recommended.
Offered: W, S]*

Prereq: PHYS 112 or 122; MATH 114 or 136; MATH 128 or 138 or 148.

Coreq: One of MATH 228, AMATH 250, AMATH 251.

Antireq: CHEM 356, NE 232, PHYS 233, ECE 405

LEARNING OBJECTIVES:

- Background: understanding why we need a quantum theory
- Learning the building blocks of a quantum theory: state vectors and operators
- Learning how to use quantum mechanics to compute probabilities for outcomes of measurements.
- Learning how to use quantum physics for technological applications.

RESOURCES:

- **Textbook (required): “Quantum Mechanics” by David H. McIntyre**
- SPINS software can be obtained using links from the following url:
<http://www.physics.oregonstate.edu/qmactivities>
- 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.
- **Recorded subject materials will be uploaded on learn regularly.** The classes will be used for discussions and problem solving. More details will be announced on learn.

COURSE OUTLINE:

- *The course lecture plan and the schedule of due dates given below will be followed as closely as possible, but some changes may occur. Any changes in assignment due dates or test dates will be discussed and announced in class and posted on the course webpage. However, the grading scheme (below) will remain the same.*

Week #	week start date	Lecture Material	Textbook Chapter
1	Jan 05	Introduction to Quantum Physics, Stern-Gerlach experiments	1
2	Jan 10	Stern-Gerlach experiments, Quantum State Vectors, and postulates of quantum mechanics	1
3	Jan 17	Quantum State Vectors, and postulates of quantum mechanics (contd.)	1
4	Jan 24	Matrix Notation, General Quantum Systems, Operators	2
5	Jan 31	Eigenvalues, and Eigenvectors, Expectation values	2

6	Feb 07	Commuting observables, Uncertainty principle, Midterm exam 1, tentative Feb 11, 2022 (syllabus: McIntyre Ch 1-2)	2
7	Feb 14	Time evolution in quantum mechanics – formalism, time independent Hamiltonian	3
8	Feb 21	Study break (Feb 19-27)	
9	Feb 28	Time evolution in quantum mechanics, Dynamics for time dependent Hamiltonians (Magnetic resonance)	3
10	Mar 07	Time evolution (contd.), Midterm exam 2 tentative Mar 11, 2022 (syllabus: McIntyre Ch 1, 2, 3)	3
11	Mar 14	Continuous quantum systems – formalism, Infinite Potential Well, quantized energy (particle in a box),	5
12	Mar 21	Tunneling through finite potential well, Free particles, concept of wave packets	5, 6
13	Mar 28	Quantum harmonic oscillator	9
14	Apr 04	Review	

ASSESSMENT:

The final score will be the higher score of the following two schemes:

- Scheme 1**
 Assignment – 30% (lowest score will be dropped)
 Quizzes – 5%
 Midterm exam 1 – 15%
 Midterm exam 2 – 15%
 Final exam – 35%
 - Scheme 2**
 Assignment – 35% (lowest score will be dropped)
 Quizzes – 5%
 Higher of Midterm exam 1, Midterm exam 2 – 20%
 Final exam – 40%
- You are encouraged to collaborate with your friends, **but you cannot copy assignments.**
 - You are not allowed to collaborate with/take help from anyone on tests/exams.
 - Weekly assignments will have 3-5 problems each, with some additional practice problems from the textbook. 1-2 problems selected by the instructor will be marked. The assignment due dates will be announced during posting.

- **Late assignments will not be accepted.** The lowest assignment score will be dropped from the final assessment. So, if you forget to submit your assignment by the deadline, or had a medical reason to skip an assignment, consider that to be your 'free' assignment! (If you think you have valid reasons for an exemption such as a chronic illness, contact the instructor.)
- **Midterm exam 1 is tentatively on Feb 11, 2022** – details will be announced later.
- **Midterm exam 2 is tentatively on Mar 11, 2022** – details will be announced later.
- **Final exam will be scheduled by the university** – details will be announced later.
- **Missed assignments and exams** – Missed exams will result in a grade of 0%. Any assignment that is not turned in on time will also receive a grade of 0%.
- **Quizzes** – in case of technical difficulties, the points will be allocated to assignments.

A student who misses an exam or assignment for a valid reason and submits a verification of illness (VIF) form or other similar form may be accommodated, at the sole discretion of the instructor. The grading system may be modified to accommodate the student, at the sole discretion of the instructor. Please discuss such situations with the instructor, preferably beforehand.

- Check appropriate uWaterloo websites for details concerning various dates (e.g., final examination, drop deadlines)

ACADEMIC INTEGRITY:

- Information about academic integrity, student discipline, grievances and appeals (the following statements are to be included in all Science outlines)
 - ***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. The [Office of Academic Integrity](#) provides relevant information for students, faculty and staff. Students are expected to know what constitutes academic integrity, to avoid committing academic offences, and to take responsibility for their actions. Completion of the [Orientation to Academic Integrity Tutorial](#) is encouraged and familiarity with [Policy #71](#), (Student Discipline) is expected. Students who are unsure whether an action constitutes an offence, or need help in learning how to avoid offences (e.g., plagiarism, cheating) or understand 'rules' for group work/collaboration should seek guidance from their course instructor, academic advisor, or the Associate Dean of Science for Undergraduate Studies. For information on typical Policy 71 penalties, students should check [Guidelines for the Assessment of Penalties](#).*
 - ***Grievance:*** *Students, who believe that a decision affecting some aspect of their university life has been unfair or unreasonable, may have grounds for initiating a grievance. Students should read [Policy #70](#), Student Petitions and Grievances, Section 4. When in doubt, students must contact the departmental/school administrative assistant who will provide further assistance.*
 - ***Appeals:*** *A decision or penalty imposed under Policy 33 (Ethical Behavior), grievances under Policy #70 (Student Petitions and Grievances) or Policy #71 (Student Discipline)*

may be appealed, if there is a ground. Petitions may not be appealed. Students who believe they have a ground for an appeal should refer to [Policy #72](#) (Student Appeals).

COURSE RULES/CONSIDERATIONS:

- Exam Period Travel:
 - Students should start checking for posted exam dates:
 - *For Fall exam dates, start checking toward the end of October.*
 - *For Winter exam dates, start checking in the middle of February.*
 - *For Spring exam dates, start checking in the middle of June.*
 - *Student travel plans are not considered acceptable grounds for granting an alternative examination time.*
- Students with Disabilities:
 - [AccessAbility Services](#), located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If students require academic accommodations to lessen the impact of their disability, they should register with AccessAbility Services at the beginning of each academic term.
- Changes to Course Outlines
 - *Revised course outlines will be posted/provided, if course details change (e.g., topics covered, emphasis on certain topics, etc.)*
 - Course elements that will **not** change are the:
 - Grading scheme
 - Course elements related to evaluation

MENTAL HEALTH SUPPORT:

Everyone needs a support system. The faculty and staff in Science encourage students to seek mental health supports, when they need them.

On Campus

- [Counselling Services](#): 519-888-4567 ext 32655
- [Health Services Student Medical Clinic](#): 519-888-4096
- [MATES](#): one-to-one peer support program (NH North); Health Services (2nd floor)
- [UW Police](#): 519-888-4567 ext. 22222

Off Campus

- [Good2Talk](#): Free confidential help line for post-secondary students / 1-866-925-5454
- [Here 24/7](#): Mental health and crisis service team / 1-844-437-3247
- [Crisis Services Canada](#): 1-833-456-4566 / text 45645
- [OK2BME](#): support services for LGBTQ teens in Waterloo / 519-884-0000 ext 213
- [Kitchener-Waterloo Sexual Assault Support Centre](#): 519-741-8633
- [Grand River Hospital](#): 519-742-3611

- [St. Mary's Hospital](#): 519-744-3311