Syllabus: Quantum Physics I (PHYC 3640)

Department of Physics and Atmospheric Science

Fall 2025

Dalhousie University operates in the unceded territories of the Mi'kmaw, Wolastoqey, and Peskotomuhkati Peoples. These sovereign nations hold inherent rights as the original peoples of these lands, and we each carry collective obligations under the Peace and Friendship Treaties. Section 35 of the Constitution Act, 1982, recognizes and affirms Aboriginal and Treaty rights in Canada.

We recognize that African Nova Scotians are a distinct people whose histories, legacies, and contributions have enriched the part of Mi'kma'ki known as Nova Scotia for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
Jesse Maassen	jmaassen@dal.ca	Wednesday, 3-5pm, Dunn 234
Mohammad Rafiee Diznab	mohammad.rafiee@dal.ca	Monday, 10am-noon, Dunn 207

Course Description

This course introduces the formal structure of quantum mechanics as well as quantum mechanical calculations. The emphasis is on problem solving. The course starts with quantum measurement, then considers particles in a box and the quantum harmonic oscillator. The course starts with one-dimensional quantum mechanics and ends with higher dimensional problems. The course introduces quantum mechanical operators, time-evolution, quantum angular momentum, and the solution of the hydrogen atom.

Course Prerequisites

PHYC 2515 ("*Modern Physics*")
PHYC 2140 ("*Physics Tools: Theory*") or PHYC 2060 ("*Oscillations and Waves*")
MATH 1030 ("*Matrix Theory and Linear Algebra I*")
MATH 2120 ("*Methods for Ordinary Differential Equations*")

Course Exclusions

None.

Student Resources

Office hours will be held weekly on Wednesdays 3-5pm in Dunn 234 (instructor's office), as well as on Mondays 10am-noon in Dunn 207 (TA's office). Students are encouraged to email or visit the instructor or TA if they have any questions.

Course Structure

Course Delivery

The course will be delivered in-person (and not recorded).

Lectures

Mondays and Wednesdays, 1:05-2:25pm, Dunn 221C.

Laboratories

None.

Tutorials

None.

Course Materials

Textbook

- "*Introduction to Quantum Mechanics*" by D.J. Griffiths and D.F. Schroeter (Cambridge University Press, 3nd edition, 2018). We will follow this textbook closely; every student should get a copy of the textbook, which is available at the Dalhousie Bookstore (link to textbook).

Other supplementary references

- "*Quantum Mechanics*" by C. Cohen-Tannoudji, B. Diu, and F. Laloë (Wiley-VCH, 1st edition, 1991).
- "*Quantum Mechanics: An Accessible Introduction*" by Robert Scherrer (Pearson, 1st edition, 2006).

Course resources, such as the syllabus and the assignments, will be made available through the course Brightspace page.

Assessment

There will be **4 assignments**, a **mid-term exam**, and a **final exam**. Assignments will be posted roughly every 2.5 weeks, with one week's time to complete and submit the work.

Assessment	Weight (% of final grade)	Due date
Assignments (4)	50% (12.5% each)	Oct. 8, Oct. 27, Nov. 24, Dec. 8
Mid-term exam	25%	Nov. 3 (during regular lecture period)
Final exam	25%	To be scheduled during the exam period.

Conversion of numerical grades to final letter grades follows the Dalhousie Grade Scale:

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Policies on Missed or Late Academic Requirements

Late assignments will have 10% deducted per day after the due date, with a maximum of 50% marks removed for lateness. In the case of illness, students must submit a Student Declaration of Absence (SDA) via email to the instructor for a missed exam or to request an extension (up to 3 days) on the due date of an assignment. For a justified missed exam, the weight of the missed exam will be added to the other exam.

Course Policies related to Academic Integrity

Regarding the assignments, discussions among students is permitted but the submitted work must present your own calculations and be written in your own words. The use of generative AI and large language models (e.g., ChatGPT) is not permitted for any assessment in this course.

Learning Objectives

- Understand and interpret the wave function
- Solve the time-independent Schrödinger equation
- Construct time-dependent solutions of the Schrödinger equation from stationary states
- Impose correct physical boundary conditions on the wave function
- Understand properties of Hermitian operators
- Compute the possible values, and associated probabilities, of observable quantities of a quantum particle
- Predict average result from a series of measurements
- Understand and apply Dirac notation

Course Content

- The wave function: Meaning of the wave function, mathematics refresher on probabilities and complex numbers, normalization, momentum, uncertainty principle
- Time-independent Schrödinger equation (1D): Stationary states, infinite square well, harmonic oscillator, free particle, delta function potential, finite square well
- Formalism: Hilbert space, observables, eigenstates of a Hermitian operator, generalized statistical interpretation, generalized uncertainty principle, vectors and operators
- Time-independent Schrödinger equation (3D): Schrödinger equation in rectangular coordinates, Schrödinger equation in spherical coordinates, solution of the hydrogen atom, angular momentum

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding Mi'kmaq and Indigenous Relations (including the Elders in Residence program, Land Acknowledgements, Understanding Our Roots, and much more) can be found at: https://www.dal.ca/about/mission-vision-values/mikmaq-indigenous-relations.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: https://www.dal.ca/about/mission-vision-values/global-relations.html

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and

procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/campus_life/ssc.html).

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: https://www.dal.ca/about/mission-vision-values/equity-diversity-inclusion-and-accessibility/about-office-equity-inclusion.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and

informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: https://www.dal.ca/content/dam/www/about/leadership-and-governance/governing-bodies/code-student-conduct.pdf

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/fair-dealing-policy.pdf

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

Student Resources and Support

University Policies and Programs

Important Dates in the Academic Year (including add/drop dates): http://www.dal.ca/academics/important_dates.html

Classroom Recording Protocol: https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/class-recording-protocol.pdf

Dalhousie Grading Practices Policies: https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/grading-practices-policy.pdf

Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html

Sexualized Violence Policy: https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/sexualized-violence-policy.pdf

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

Learning and Support Resources

General Academic Support – Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html

General Academic Support – Advising (Truro): https://www.dal.ca/campus_life/ssc.html

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Mi'kmaq and Indigenous Relations: https://www.dal.ca/about/mission-vision-values/mikmaq-indigenous-relations.html

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student

Centre or contact the program at elders@dal.ca or 902-494-6803: https://www.dal.ca/about/mission-vision-values/mikmaq-indigenous-relations/elders-in-residence-and-traditional-knowledge-keepers.html

Black Student Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre.html

LGBTQ2SIA+ Collaborative: https://www.dal.ca/about/mission-vision-values/equity-diversity-inclusion-and-accessibility/about-office-equity-inclusion/community-specific-groups/lgbtq2sia-collaborative.html

Dalhousie Libraries: http://libraries.dal.ca/

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Dalhousie Student Advocacy Services: https://www.dsu.ca/dsas?rq=student%20advocacy

Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/ombudsperson.html

Human Rights and Equity Services: https://www.dal.ca/about/mission-vision-values/equity-diversity-inclusion-and-accessibility/about-office-equity-inclusion/human-rights-and-equity-services.html

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Faculty of Science Advising Support: https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html

Safety

Biosafety: http://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: http://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Laser Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html