

We recognize and acknowledge that McMaster University meets and learns on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the "[Dish With One Spoon](#)" wampum, an agreement amongst all allied Nations to peaceably share and care for the resources around the Great Lakes.

PHYSICS 3MM3 – Quantum Mechanics I

2021 Fall Term

Instructor: Patrick Clancy | **E-mail:** clancyp@mcmaster.ca | **Office Hours:** Mo & Th 10:00 - 11:00AM

Teaching Assistants: Wyatt Kirkby		E-mail: kirkbyw@mcmaster.ca		Office Hours: TBD
Liam Farrell		E-mail: farrel5@mcmaster.ca		Office Hours: TBD
Jury Radkovski		E-mail: radkovsj@mcmaster.ca		Office Hours: TBD

Course Description

Quantum physics in 1D and 3D systems, with applications including the hydrogen atom.

Prerequisite(s): Credit or registration in [MATH 3C03](#), and one of [ENGPYS 2QM3](#), [PHYSICS 2C03](#), 3M03; or registration in [Honours Mathematics and Physics \(B.Sc.\)](#)

Course Expectations

The course will be organized as follows:

- 2-3 live lectures/discussions per week in the virtual classroom
- Weekly pre-recorded lecture videos
- 6 assignments
- Computational exercises using python (included in the biweekly assignments)
- 2 in-class midterm tests
- 1 final exam

Class Schedule

Day(s):	Mo		Time/Duration: 3:30 - 4:20PM		Location: Virtual Classroom
	Tu		Time/Duration: 4:30 - 5:20PM		Location: Virtual Classroom
	Th		Time/Duration: 3:30 - 4:20PM		Location: Virtual Classroom

Course Website

<http://avenue.mcmaster.ca/>



Course and Learning Objectives

Learning Objectives

By the end of this course, students should be able to:

- Explain the fundamental principles of quantum mechanics, including wave-particle duality, the statistical interpretation, and the uncertainty principle
- Solve quantum mechanical problems ranging from simple potential wells in one-dimension to the Hydrogen atom in three-dimensions
- Understand basic atomic structure arising from the Hydrogen atom
- Understand spin and angular momentum quantum numbers

Materials & Fees

Required Materials/ Resources

Required Text:

Introduction to Quantum Mechanics, David J. Griffiths and Darrel F. Schroeter (3rd Edition, Cambridge University Press)

Suggestions for Further Reading (Optional):

Principles of Quantum Mechanics, R. Shankar (Springer)

Quantum Mechanics, vol. 1 and vol. 2, C. Cohen-Tannoudji, B. Diu, and F. Laloe (Wiley)

Virtual Course Delivery

To follow and participate in virtual classes it is expected that you have reliable access to the following:

- A computer that meets performance requirements [found here](#).
- An internet connection that is fast enough to stream video.
- Computer accessories that enable class participation, such as a microphone, speakers and webcam when needed.

If you think that you will not be able to meet these requirements, please contact uts@mcmaster.ca as soon as you can. Please visit the [Technology Resources for Students page](#) for detailed requirements. If you use assistive technology or believe that our platforms might be a barrier to participating, please contact [Student Accessibility Services](#), sas@mcmaster.ca, for support.



Course Overview and Assessment

Course Schedule

Week Number	Begins	Topics
1	Sep 06	<ul style="list-style-type: none"> 1.1-1.2 The Schrödinger Equation, Statistical Interpretation 1.3-1.4 Probability, Normalization
2	Sep 13	<ul style="list-style-type: none"> 1.5-2.1 Momentum, Uncertainty Principle, Stationary States 2.2 Infinite Square Well
3	Sep 20	<ul style="list-style-type: none"> 2.3 Harmonic Oscillator
4	Sep 27	<ul style="list-style-type: none"> 2.4 Free Particle
5	Oct 04	<ul style="list-style-type: none"> 2.5 Delta function Potential
-	Oct 11	<ul style="list-style-type: none"> Fall Break
6	Oct 18	<ul style="list-style-type: none"> 2.6 Finite Square Well 3.1-3.2 Hilbert Space, Observables
7	Oct 25	<ul style="list-style-type: none"> 3.3 Hermitian Operators, Eigenfunctions 3.4-3.5 Generalized Statistical Interpretation, Uncertainty Principle
8	Nov 01	<ul style="list-style-type: none"> 3.6 Dirac Notation, Matrix Mechanics
9	Nov 08	<ul style="list-style-type: none"> 4.1 Schrödinger Equation in Spherical Coordinates
10	Nov 15	<ul style="list-style-type: none"> 4.2 Hydrogen Atom
11	Nov 22	<ul style="list-style-type: none"> 4.3 Angular Momentum
12	Nov 29	<ul style="list-style-type: none"> 4.4 Spin
13	Dec 06	<ul style="list-style-type: none"> Review/Makeup Class

Evaluation

Assessment	Due Date	Weight
Assignments #1 – 6	~ Every 2 weeks	50%
Midterm #1	Tues, Oct. 5 th	10%
Midterm #2	Tues, Nov. 9 th	10%
Final Exam	TBD	30%
Total		100%

Requests for Relief for Missed Academic Term Work

[McMaster Student Absence Form \(MSAF\)](#): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”.

For the Faculty of Science, please follow the guidelines located [here](#).

Policy Regarding Missed Work

1. It is the students’ responsibility to regularly check the course webpage (ex. Avenue to Learn) for updates and announcements.
2. In the event that you use a MSAF for an assignment you will receive a one week extension on the deadline, but you will still have to hand in the assignment.
3. If you use a MSAF for a midterm then a makeup test will be scheduled.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact [Student Accessibility Services \(SAS\)](#) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

Physical and Mental Health

For a list of McMaster University’s resources, please refer to the [Student Wellness Centre](#).

Academic Accommodation for Religious, Indigenous or Spiritual Observances (Riso)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Equity, Diversity, and Inclusion

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Physics & Astronomy is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexualities, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Chair of Undergrad Studies, Undergraduate Advisor (Level I), and/or Undergraduate Advisor (Levels II to IV) (contact details listed [here](#)) or to contact the [Equity and Inclusion Office](#).

Courses with An On-Line Element

Online Statement

McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

Some courses may use various on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, LON-CAPA, Microsoft Teams, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with Sara Cormier (phys1Acoord@physics.mcmaster.ca).

McMaster University Statement on Inclusivity

The University values integrity, inclusiveness and teamwork, and strives to support the personal and collective growth of the McMaster student community.

These values are foundational to ensuring campus environments – both in-person and virtual – are conducive to personal wellbeing and academic success

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

It is your responsibility to understand what constitutes academic dishonesty.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Some helpful information can be found [here](#).

Authenticity / Plagiarism Detection

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not

submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to the [McMaster Office of Academic Integrity's](#) website.

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities \(the "Code"\)](#). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Additional information about the Code and netiquette can be found [here](#).

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Research Ethics -N/A

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.