

# CHM 423H: Applications of Quantum Mechanics

## Course Syllabus Fall 2023

### I CONTACTS

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#### INSTRUCTOR

*Name:* Paul Brumer

*Email:* paul.brumer@utoronto.ca

*Office:* Lash Miller, Room 421B

*Classes:* Classes are scheduled to be held Monday 4:00PM-6:00PM. In addition, office hours will be held over zoom on Fridays between 1:30-2:30 PM. If this zoom time prove to be inconvenient, we can change it after class discussion.

Topic: CHM423 Lectures - Monday 4PM - 6PM

Room: WE76 Wetmore Hall - New College

Bring your laptops with access to Quercus.

Topic: Office Hours CHM432 – Friday 1:30-2:30PM over zoom.

Meeting ID: 848 4472 0124

Passcode: 716 070

#### TEACHING ASSISTANTS

There are no tutorials or TA's for this class. We will discuss approaches to interactions between class participants during the first lecture.

### II COURSE OVERVIEW

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#### COURSE DESCRIPTION:

**Classes** will be concerned with time dependent quantum mechanics, with applications to spectroscopy, with elementary continuum processes and with quantum- classical correspondence.

#### STUDENT LEARNING OUTCOMES:

By the end of this course, students will have learned:

- Aspects of time-dependent quantum mechanics
- Introductory scattering theory
- Theory of laser spectroscopy
- Understanding the emergence of classical mechanics from quantum theory.
- Problem solving techniques

#### BACKGROUND PREPARATION:

Essential: CHM 326H (which also required MAT235Y/237Y)

## READINGS:

Required:

- (1) *Introduction to Quantum Mechanics: A Time Dependent Perspective*, by David Tannor, University Science Books.
- (2) *Quantum Theory*, by David Bohm, Dover Publications

We will make extensive use of these books in the lectures, so students should ensure that they have legal access to these texts, (by, e.g., purchasing the books or via university library access

## III HOW THE COURSE IS ORGANIZED

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Lecture notes will be posted on Quercus and used as the basis for detailed discussion during the course lectures. Students should have access to the notes during the lectures.

Homework problems will be assigned approximately every other week and will be (partially or fully) graded. The homework schedule may be changed to accommodate students progress in the course.

The following is a *rough* schedule. We will follow Time-dependent quantum mechanics (Tannor's book, Chapters 1-3), followed by issues in classical- quantum correspondence as well as elementary continuum problems (Bohm's book, Chapters 11-12), followed by a study of time dependent spectroscopies (parts of Chapters 13, 14 and 16 of Tannor's book). The pace adopted will be adjusted to students' progress in the course.

## IV EVALUATION/GRADING SCHEME

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- Biweekly problem sets: worth 35% of final mark
- Term paper: worth 30% of final mark. Due prior to final assessment period. Content to be discussed during lecture hours.
- Final assessment: to be held during final assessment period, worth 35% of final mark.

**Note:** if an unexpected technical issue occurs with a university system (e.g., Quercus services, network outage) that affects availability or functionality, it may be necessary to revise the timing or weighting of the assessments.

**Use of ChatGPT or similar programs for any of these assignments is strictly forbidden!**

## V COURSE POLICIES

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- The University of Toronto is committed to equity, human rights, and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community

can express themselves, engage with each other, and respect one another's differences. We will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and wish to be alerted to any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated. If you have any questions, comments, or concerns, we encourage you to reach out to the staff in our Equity Office.

- All work must be submitted via Quercus.
- If you are absent from your studies due to illness or other reasons and unable to complete course work (e.g., a term test or an assignment) then a piece of written documentation is required. The following four items are the recognized forms of documentation:
  - 1. [Absence Declaration via ACORN](#) (please note the circumstances under which an absence declaration can and cannot be submitted)
  - 2. [U of T Verification of Illness or Injury Form](#)
  - 3. College Registrar's letter
  - 4. Letter of Academic Accommodation from Accessibility Services
- Students who complete the ACORN Absence Declaration form must additionally contact me/the course coordinator/the course administrator to discuss their situation within five business days of the missed piece of work. This is essential action for any consideration to be granted.
- For extended absences and for absences due to non-medical reasons, make sure to contact your [College Registrar's Office](#). They can help you decide between a request for an extension or other types of academic consideration.

## VI TECHNOLOGY REQUIREMENTS

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Specific guidance from the U of T Vice-Provost regarding student technology requirements is available here:

<https://www.vicereprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/>

Advice for students more broadly regarding online learning is available here:

<https://onlinelearning.utoronto.ca/getting-ready-for-online/>

This course requires the use of computers, and technical issues are possible. When working on a piece of academic work, students are responsible for scheduling enough time to allow for reasonable delays due to technical difficulties to be overcome, so such issues will not be acceptable grounds for deadline extension. Particularly, maintaining an up-to-date independent backup copy of your work is strongly recommended to guard against hard-drive failures, corrupted files, lost computers, etc.

## **VII INSTITUTIONAL POLICIES AND SUPPORT**

### **ACADEMIC INTEGRITY**

#### **On Academic Integrity:**

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see <https://www.academicintegrity.utoronto.ca/>).

### **COPYRIGHT**

If a student wishes to copy or reproduce class presentations, course notes or other similar materials provided by instructors, he or she must obtain the instructor's written consent beforehand. Otherwise, all such reproduction is an infringement of copyright and is absolutely prohibited. More information regarding this is available at <https://teaching.utoronto.ca/ed-tech/audio-video/copyright-considerations/>

**Please note that the use of websites (such as Chegg.com or the course discussion board) to post/quiz/term test questions or to post/access answers to questions is an academic offence under the University of Toronto's Code of Behaviour on Academic Matters. Alleged instances of this nature are forwarded to the Faculty of Arts & Sciences Student Academic Integrity office.**

## **ACCESSIBILITY NEEDS**

Students with diverse learning styles and needs are welcome in this course. The University of Toronto is committed to accessibility: if you require accommodations for a disability, or have any other accessibility concerns about the course, please contact [Accessibility Services](#).

## **ADDITIONAL SERVICES and SUPPORT**

The following are some important links to help you with academic and/or technical service and support:

- General student services and resources at Student Life
- Full library service through University of Toronto Libraries
- Resources on conducting online research through University Libraries Research
- Resources on academic support from the Academic Success Centre
- Learner support at the Writing Centre
- Information for Technical Support/Quercus Support

## **ACCOMMODATION FOR RELIGIOUS OBSERVANCES**

Following the University's policies, reasonable accommodations will be made for students who observe religious holy days that coincide with the due date/time of an assignment, tutorial, class or laboratory session. Students must inform the instructor before the session/assignment date to arrange accommodations.

## **ACKNOWLEDGEMENT OF TRADITIONAL LANDS**

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca and, most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home of many indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.