

CHM 326: Introductory Quantum Mechanics and Spectroscopy

Fall 2020 Course Syllabus

I Instructor

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II COURSE OVERVIEW

Welcome to **CHM326H *Introductory Quantum Mechanics and Spectroscopy***

Quantum mechanics is a remarkable subject. Einstein (who won the Nobel Prize for his contributions to the foundations of quantum mechanics) wrote, "The more success the quantum theory has, the sillier it seems." At the same time, it is the most successful theory ever developed, judging by the accuracy and precision of its description and its wide ranging applicability.

This course provides an introduction to this subject. Guided by experimental results, it starts from postulates and develops the fundamental framework of quantum theory. A number of exactly soluble problems are treated in detail. Perturbation theory is introduced, and various applications to molecular spectroscopy and dynamics are covered in detail.

EXCLUSIONS AND PREREQUISITE COURSE(S):

Exclusions: JCP321H5

Pre-requisites: CHM225Y/(CHM220H/222H, 221H/223H), MAT235Y/237Y

TEXTBOOK:

- I. Levine, QUANTUM CHEMISTRY, 7th ed. Prentice Hall, 2009 (including Solution Manual) ISBN 0132090856; OR
- II. McQuarrie's Quantum Chemistry (Rev. 2nd Ed., 2007), from University Science Book ISBN 978-1-891389-50-4

OUTLINE:

1. Operators
2. Postulates of Quantum Mechanics and Their Basis in Experiment
3. Particle-in-a-box and Applications to Molecules and Quantum Dots
4. Harmonic Oscillator and Vibrational Spectroscopy
5. Angular Momentum, Rigid Rotor and Rotational Spectroscopy
6. Hydrogen Atom
7. Variational Method
8. Perturbation Theory

LEARNING OUTCOMES:

- Describe the postulates of quantum mechanics
- Write time the dependent Schrodinger's equation, separate variables for time-independent potentials and derive the time-independent Schrodinger's equation

- Solve the time-independent Schrodinger's equation for particle-in-a-box, outline the derivation and solutions (exact, approx.) for various other potentials, and relate the solutions to experiment
- Explain and apply superposition of solutions

III HOW THE COURSE IS ORGANIZED

CLASSES:

Classes will be live-streamed on Mondays and Fridays 2:10 - 3 EST, and additionally recorded for students who are unable to attend live. It is essential that you attend the live classes and/or review the recordings afterwards in order to solidify your understanding of the fundamental course material.

IMPORTANT FALL 2020 SESSIONAL DATES:

First Day of F & Y classes: Tuesday 15th September 2020

Thanksgiving (no classes): Monday 12th October 2020

Fall Reading Week (no classes): Monday 9th – Friday 13th November 2020

Last Day of classes: Tuesday 8th December 2020

IV EVALUATION/GRADING SCHEME

Assignments (approx. 4 total, approx. 1 every 2-3 weeks): 25% total
3 tests @ 25% each will be held on the dates given below: 75% total

- **OCTOBER 2, 2020**
- **OCTOBER 30, 2020**
- **NOVEMBER 27, 2020**

NOTES ON ASSESSMENT

- Assignments must be:
 - hand written,
 - scanned or photographed clearly, and saved as a **PDF file** (e.g. you may insert images of your assignment in Powerpoint and save the Powerpoint file as PDF),
 - emailed to steven.gravelsins@mail.utoronto.ca from your utoronto.ca account with the email subject containing "chm326 student: LastName_FirstName, student number"
 - attached as a PDF file and identified with your student number and name (with last name underlined) clearly written on the first page.
- Grades for **late assignments** will be reduced by 10% per day up to 5 days. After that, solutions will be posted, and a grade of 0% will be assigned.
- Test questions can be drawn from any material taught before the test date.
- Students who require consideration for missed academic work should report their absence through the online absence declaration. The declaration is available on [ACORN](#) under the Profile and Settings menu. Students must also advise Prof. Dhirani by email. If 1 test is missed, 2 tests and assignments will be weighted 1/3 each. If more tests are missed, an oral, online make-up test will be provided.

V COURSE POLICIES

- Course website: q.utoronto.ca
Important: please check the Quercus course website regularly (weekly!) for:
 - ✓ general course information
 - ✓ lectures
 - ✓ important announcements
- Email will generally be responded to if: (1) You send it from your utoronto.ca account; (2) You identify yourself in the e-mail subject using “chm326 student: LastName_FirstName, student number”. Please note that chemistry can be discussed through an online discussion arranged by appointment much more effectively than by email, and that email is not a substitute for attending classes.
- 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. U of T does not condone discrimination or harassment against any persons or communities.
- Aspects of this course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session. Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright: for questions about recording and use of videos in which you appear please contact your instructor. Students may not create audio recordings of classes with the exception of those students requiring an accommodation for a disability, who should speak to the instructor prior to beginning to record lectures. Students creating unauthorized audio recording of lectures violate an instructor’s intellectual property rights and the Canadian Copyright Act. Students violating this agreement will be subject to disciplinary actions under the Code of Student Conduct. Course videos may not be reproduced or posted or shared anywhere other than the official CHM 326 Quercus site and should only be used by students currently registered in the course. Recordings may be saved to students’ laptop for personal use. Because recordings will be provided for all classes, students may not create additional audio or video recordings without written permission from the instructor. Permission for such recordings will not be withheld for students with accommodation needs.

VI TECHNOLOGY REQUIREMENTS

- This course requires the use of computers, and unfortunately sometimes things can go wrong when using them. You are responsible for ensuring that you maintain regular backup copies of your files, use antivirus software (if using your own computer), and schedule enough time when completing an assignment to allow for delays due to technical difficulties. Computer viruses, crashed hard drives, lost or corrupted files, incompatible file formats, and similar mishaps are common issues when using technology, and are not acceptable grounds for a deadline extension.

- Specific technology requirements are required in order to participate and learn effectively in CHM 326. Some guidance from the U of T Vice-Provost, Students regarding this is available here: viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning
- If you are new to online learning, some general advice and tips for students is available here: onlinelearning.utoronto.ca/getting-ready-for-online

VII INSTITUTIONAL POLICIES AND SUPPORT

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 (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 papers and 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 www.academicintegrity.utoronto.ca/).

ACCESSIBILITY NEEDS

Students with diverse learning styles and needs are welcome in CHM 326. 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](#) as soon as possible.

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](#)