CHM 326: Introductory Quantum Mechanics and Spectroscopy

Fall 2022 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, judging by the accuracy and precision of its description and its wide ranging applicability, quantum mechanics is the most successful theory ever developed.

This course provides an introduction to this subject. The course will start from postulates and develop the fundamental framework of quantum mechanics. Perturbation theory is introduced. A number of exactly soluble problems are treated in detail, and various applications to atoms, molecules, materials, spectroscopy and dynamics are covered in detail. Throughout the course, we will highlight links between theory and experiment. Yes, this stuff really works!

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 held on Mondays and Fridays 2:10 - 3 EST. It is essential that you attend the classes in order to solidify your understanding of the fundamental course material.

IMPORTANT FALL 2022 SESSIONAL DATES:
First Day of F & Y classes: Thursday 8th September 2022
Thanksgiving (no classes): Monday 10th October 2022
Fall Reading Week (no classes): Monday 7th – Friday 11th November 2022
Last Day of classes: Wednesday 7th December 2022

IV EVALUATION/GRADING SCHEME

Assignments (approx. 4 total, approx. 1 every 2-3 weeks): 20% total
A final exam held during the December examination period: 30%
2 tests @ 25% each will be held on the dates given below: 50% total

- **OCTOBER 7, 2022**
- **NOVEMBER 18, 2022**

NOTES ON ASSESSMENT

- Assignments must be:
    - hand written,
    - stapled,
    - 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, your grade out of 75% for the remaining assessments will be scaled to 100%. If both tests are missed, an oral make-up test will provided.

V COURSE POLICIES

- Course website: q.utoronto.ca

  Important: please check the Quercus course website regularly (weekly!) for:

  - ✓ general course information
  - ✓ lecture notes
  - ✓ assignments
  - ✓ 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 a live 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.

VI 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