CHM326H1 F

Introductory Quantum Mechanics and Spectroscopy

Fall 2024 Syllabus

Course Meetings

CHM326H1 F

Section	Day & Time	Delivery Mode & Location
LEC0101	Monday, 2:00 PM - 3:00 PM Friday, 2:00 PM - 3:00 PM	In Person: UC 87 In Person: UC 87
TUT0101	Wednesday, 11:00 AM - 12:00 PM	In Person: RW 140

Refer to ACORN for the most up-to-date information about the location of the course meetings.

Course Contacts

Course Website: https://q.utoronto.ca/courses/358623

Instructor: Al-Amin Dhirani
Email: a.dhirani@utoronto.ca
Office Hours and Location: After class and by appointment

Course Overview

This course introduces the postulates of quantum mechanics to develop the fundamental framework of quantum theory. A number of exactly soluble problems are treated in detail as examples. Perturbation theory is introduced in the context of understanding many body problems. Various applications to chemical bonding and molecular spectroscopy are covered in detail.

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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

Course 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
- Be able to solve the problems solved in class, tutorials and homeworks

Prerequisites: (CHM220H1/ CHM222H1, CHM223H1), MAT235Y1/ MAT237Y1
Corequisites: None
Exclusions: JCP321H5, PHY356H1
Recommended Preparation: None
Credit Value: 0.5

Course Materials

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

Marking Scheme

Assessment	Percent	Details	Due Date
Term test 1	25%		2024-10-11
Term test 2	25%		2024-11-15
Assignments	20%		No Specific Date
In-Person Final Exam	30%		Final Exam Period

Policy for reweighting due to missed pieces of academic work: Note the requirement for documentation

- **Missed tests:** 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.
- **Missed homework:** your course grade will be reweighted. For example, if you miss an assignment worth 5%, your grade out of 95% will be scaled to 100%.

Late Assessment Submissions Policy

• Policy for late assignments: 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.

Policies & Statements

Religious Accommodations

As a student at the University of Toronto, you are part of a diverse community that welcomes and includes students and faculty from a wide range of cultural and religious traditions. For my part, I will make every reasonable effort to avoid scheduling tests, examinations, or other compulsory activities on religious holy days not captured by statutory holidays. Further to University Policy, if you anticipate being absent from class or missing a major course activity (such as a test or in-class assignment) due to a religious observance, please let me know as early in the course as possible, and with sufficient notice (at least two to three weeks), so that we can work together to make alternate arrangements.

Students with Disabilities or Accommodation Requirements

Students with diverse learning styles and needs are welcome in this course. If you have an acute or ongoing disability issue or accommodation need, you should register with Accessibility Services (AS) at the beginning of the academic year by visiting https://studentlife.utoronto.ca/department/accessibility-services/. Without registration, you will not be able to verify your situation with your instructors, and instructors will not be advised about your accommodation needs. AS will assess your situation, develop an accommodation plan with you, and support you in requesting accommodation for your course work. Remember that the process of accommodation is private: AS will not share details of your needs or condition with any instructor, and your instructors will not reveal that you are registered with AS.

Academic Integrity

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019). If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to me. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources. For example, to learn more about how to cite and use source material appropriately and for other writing support, see the U of T writing support website at http://www.writing.utoronto.ca. Consult the Code of Behaviour on Academic Matters for a complete outline of the University's policy and expectations. For more information, please see A&S Student Academic Integrity (https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity) and the University of Toronto Website on Academic Integrity (https://www.academicintegrity.utoronto.ca).

Assignment Submission Method

Assignments must be:

- hand written,
- stapled,
- identified with your student number and name (with last name underlined) clearly written on the first page
- submitted on due dates (provided on the assignment) at the beginning of class

Online Communication

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.

Expectations of course members

Each member of this course is expected to maintain a:

(i) professional and respectful attitude during all course activities, including classes, laboratories, tutorials, and online activity.

(ii) personal calendar/schedule/organizer to ensure that all course activities are completed, and due dates are met.

(iii) collection of notes recorded independently based on concepts covered in course activities (students registered with Accessibility Services requiring a class note-taker will have access to this accommodation)

(iv) familiarity with the university policy on Academic Integrity (overleaf)

Equity, Diversity and Inclusion

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.

Attendance

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 the instructor 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.

Course Materials, including lecture notes

Course materials and lectures are for the exclusive use of enrolled students. These should not be reposted, shared, put in the public domain, or otherwise distributed without the explicit permission of the instructor. They belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Students violating these policies will be subject to disciplinary actions under the Code of Student Conduct.

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

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 to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.