Quantum Mechanics

Course Syllabus – spring 2026

Catalog Description

Quantum Mechanics is a 3-credit technical elective course intended for junior and senior undergraduate students at SCUPI. This course will deliver quantum mechanics from chemical and spectroscopic perspectives, rooting in the description of how microscopic particles (electrons, photons, etc.) behave and their stark difference with respect to macroscopic bulk materials, which are dominated by classical mechanics. Upon completion of this course, it is expected that students can develop fundamental understanding of wave-particle duality of quantum particles, and utilize quantum mechanical principles to calculate energy and energy levels of quantum confinement systems, and most importantly, to conceive relevant modeling of molecules or complex chemical systems.

Course Instructor

Dr. Jue Gong, jue.gong@scupi.cn

Office hours: Thursday 10:00 am-12:00 pm, Friday 10:00 am-12:00 pm, 02:30-04:30 pm, or by appointment

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Course Objectives

This course aims to convey fundamental principles of quantum mechanics with emphasis on chemical systems (single atoms, molecules, materials) and spectroscopy techniques including atomic, vibrational/rotational and electronic spectroscopy, detailing the energy discrete and wave natures of quantum particles (electrons, photons, etc.). After studying the course, students are expected to demonstrate knowledge in solving Schrodinger equations for hydrogen atoms and many-electron atoms, accounting for the behavioral differences between microscopic and macroscopic objects using Heisenberg uncertainty principles and particle in box models. Moreover, along with the quantum mechanical principles and models mentioned above, students are expected to demonstrate understanding of quantum mechanics in real-world material, physics, and chemistry phenomena, such as tunneling in chemical reactions, why hydrogen-hydrogen nuclear fusion is possible, the working mechanisms of conductors/semiconductors/insulators, and their relevance to quantum entanglement, quantum computation, and

quantum communications. Finally, the course will also touch upon compare-and-contrast between general relativity and quantum mechanics, and briefly interpret the current development and challenges of unifying these two most important pillars of modern physics into theory of everything.

Lecture Schedule

Monday: 08:15-11:55 am (week 1-12), location: SCUPI new building south S104

Textbook

Thomas Engel, Philip Reid, Quantum Chemistry & Spectroscopy, 4th Edition, Pearson. ISBN: 978-0134804590

Auxiliary readings include: Quantum Mechanics I, by Qiao Gu (顾樵) (科学出版社)

Concise Quantum Mechanics (简明量子力学), by Biao Wu (吴飙) (北京大学出版社)

Teaching Assistant

Due to under-numbered students that should reach (25) in order to recruit TA, this course does not have TA at this point.

Grading

Total score of the course grading is 100 points.

Homework: 20%

Class attendance: 10%

In-class quiz/presentation: 10%

Midterm exam: 30%

Final exam: 30%

Exams

There will be two examinations of this course—midterm and final, which are to be tentatively scheduled on 04/13 (Friday) and 06/01 (Saturday) of the spring semester, respectively, abide by the 12-week class schedule of this course. Exams are close-book, comprising questions including single-choice, Q&A, and mathematical calculation as the formats. A calculator and a double-side equation sheet are allowed for each student. Midterm and final exams each weighs 30% and 30% of the course grade. Students are thus strongly suggested to study and prepare for the exams properly ahead of taking the tests.

Grading Rebuttal

If you disagree with the grading or to dispute wrongful errors made in the grading of an assignment, please bring it to the attention of course instructor within one week of receiving the assignment back for resolution.

Homework

Homework is based on problems after each chapter of the textbook, and will be posted on Blackboard system after the corresponding lecture. Homework score constitutes 10% of the class grading. Therefore, students are expected to submit after-class homework on time, within a week after the lecture, to avoid any deduction of credit. Collaboration with other students in the class is allowed. However, all rendered write-ups and papers must be individual works and any type of plagiarism will not be tolerated. If you have objection to the received score after getting your homework back, please notify the course teaching assistant. Please also take note of the following homework guidelines:

1) Your homework assignment must be completed in a Word format and submitted electronically through Blackboard system, with naming convention "Course#-name-student ID-Hw#". Handwritten assignments (or snapshots of handwritten works) will not be accepted.
2) Write your name, last four digits of student ID#, and class section# on top of the first page.
3) If you participate in collaboration with other students, please also put their names on the first page of the submitted homework.

Class Attendance

Attendance at lectures is mandatory as it constitutes 10% of the course's total grading. It is highly suggested that you come to class prepared, which includes reviewing last lecture's content, previewing lecture's content, reading online handouts, and going through potential problems, so as to enhance learning efficacy.

Make-up Policy

If you have TOEFL/IELTS test schedule, sick leave with justified approval, or other issues that make you miss lecture, homework, reports, and/or exams, please inform course instructor at your earliest convenience.

Accommodations

If you sustain disability or sickness that requires testing and/or classroom accommodations, please notify the course instructor, TA, and the university's Disability Resources and Services in time. You may be asked to present proof of disability or sickness to be provided the accessibility accommodations.

Academic Integrity

Plagiarism of any forms that include copying peers' works, writings, literatures, and online references without appropriate paraphrasing or full citations, cheating within an exam, infringing copyrighted works or other

improper conducts constitutes academic dishonesty. It is a requirement that every student performs independent and collaborations under the academic guidelines set forth by the SCUPI, Sichuan University, and University of Pittsburgh to ensure rightful learning performance.

Tentative Schedule of Course Contents

Sequence of sections covered in this class:

Week	Contents	Descriptions
1 (03/09)	1.1 – 1.7	Blackbody radiation, photoelectric effect, particle-wave duality, double-slit diffraction, atomic spectra, Bohr model
2 (03/16)	2.1 – 2.7	Schrodinger equation
3 (03/23)	3.1 – 4.4	Quantum-mechanical postulates and application of quantum-mechanical principles to simple systems
4 (03/30)	5.1 – 5.9	Application of particle in the box model to real-world topics
5 (04/06)	6.1 – 6.6	Commuting and noncommuting operators and the surprising consequences of entanglement
6 (04/13) (tentative schedule of midterm exam in this week)	7.1 – 7.8	Quantum-mechanical model for the vibration and rotation of molecules
7 (04/20)	8.1 – 8.9	Vibrational and rotational spectroscopy of diatomic molecules
8 (04/27)	9.1 – 9.6	Using Schrodinger equation for hydrogen atom
9 (05/04) (holiday, subject to change)	10.1 – 10.6	Using Schrodinger equation for many-electron atoms
10 (05/11)	11.1 – 11.8	Quantum states for many-electron atoms and atomic spectroscopy
11 (05/18)	12.1 – 12.9	Chemical bonds in diatomic molecules
12 (05/25)	14.1 – 14.14	Electronic spectroscopy, relativity, and the current difficulty of unifying quantum mechanics with general relativity
13 (06/01)	Final exam	Final exam covers whole semester’s contents