Quantum Mechanics [PH2050-Fall-2023]

Lecturer: Professor Xinsheng Sean Ling

August 26, 2023

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Lecture Hours: MW 8:30-9:50 am
Lecture Hall: Barus-Holley 166
Office Hours: Tu 2:00-3:00pm, or by appointment via zoom.

Course contents: Wave description of particles. Wave mechanics and the Schrodinger equation. Fundamental principles and postulates. Symmetry transformations. Time evolution and stationary states. Theory of angular momentum. Advanced topics: Quantum information, Superfluidity, and other topics if time permits. Our objective is to cover the first four chapters of Sakurai's textbook.

Prerequisites: Knowledge of basic undergraduate Hamiltonian Mechanics and Electromagnetism as well as a comfortable familiarity with standard Modern Physics (at the level of the recommended textbook listed below).
Required textbook: Modern Quantum Mechanics by J. J. Sakurai - Jim Napolitano (ISBN: 9781108422413)
Recommended textbook: Quantum Physics, 3rd Edition, Stephen Gasiorowicz, ISBN: 978-0-471-05700-0

Exams:
In-class mid-term exams: Oct.16, Nov.20
Final exam Date: 21-DEC-2023 Exam Time: TBA

Grading Policy:
Homework 30%
Midterm-1 20%
Midterm-2 20%
Final 30%

Lectures
All lectures will take place in BH-166 on Mondays and Wednesdays, from 8:30-9:50am EDT. Attendance at the lectures is required. Lectures will be recorded so that students who are unable to attend for health reasons can make up the missed material. Lectures and demonstrations complement the reading and do not substitute for it. It is essential to both do the reading and attend the lectures.

Homework
Homework assignments are usually due at the end of each week with some exceptions as noted in the course schedule and have to be submitted online via Canvas. The assignment with the worst score will be dropped when computing the homework score to give a break to students who are unable to complete a particular assignment on time due to illness, family/personal difficulties, etc., while at the same time provide fairness to others so that everyone has the same amount of time to complete the assignments. Solutions will be posted on Canvas shortly after the due date. Therefore no late homework will be accepted. It is in your best interest to complete all the problem sets. Students are encouraged to work together and attend TA office hours for help with the homework. But it is essential (and required by Brown's academic code) that you solve and understand each problem by yourself. Copying from other students, from the web, or from other sources is a violation of the academic code.

Exams
The two midterm exams will take place during class on Oct.16 and on Nov.20 in BH-166. Final Exam Date: 21-Dec-2023 Canvas All course material can be accessed from the Canvas site of the course.

Time Commitment The course activities include 2 weekly lectures (35h), textbook readings (65h), homework assignments (50h), two midterm exams, and a final exam (30h) for a total of 180h over the semester. This is an estimate and your actual experience may not match exactly.

Academic Conduct Code

Students enrolled in this course are expected to follow the Brown University Student Code of Academic Conduct for all assignments.

Diversity and Inclusion

It is my goal to create a learning environment in this course that is supportive and embraces a diversity of perspectives and experiences. If you have a preference for a name and/or a set of referential pronouns that differ from those that appear in your official Brown records, please let me know by e-mail. If any aspect of the in-class environment is impeding your learning physics, please let me know. If you prefer to maintain anonymity, please contact Dean Bhattacharya, Associate Dean of the College for Diversity Programs, or one of the Physics Department Diversity Officer (currently Profs. Alexander, Dell'Antonio, and Pober). If you feel that your performance in this class is being impacted by your experiences outside of class, please don't hesitate to come and talk with me. I want to be a resource for you. If any of my statements or actions make you uncomfortable, please tell me (or provide anonymous feedback through the channels above) so that I can correct the situation.

Accessibility and Accommodations

Brown University is committed to full inclusion of all students. Please inform me early in the term if you have a disability or other conditions that might require accommodations or modification of any course procedures. You may speak with me after class or during office hours. For more information, please contact Student and Employee Accessibility Services at 401-863-9588 or SEAS@brown.edu. Students in need of short-term academic advice or support are encouraged to contact one of the deans in the Dean of the College office. Students seeking psychological support services should contact Counseling and Psychological Services.

Chapter 1: Quantized States and Quantum Mechanics
Dates of lectures: Sept.6,11,13,18,20, 25

Quick review of modern physics
Stern-Gerlach, Davisson-Germer experiments.
Dirac notations for states and observables.
Hilbert space
Observation and uncertainty

Chapter 2: Quantum Dynamics
Dates of lectures: Sept.27, Oct.2,4,11,16(mid-1),18

Schrodinger picture.
Example: spin precession.
Heisenberg picture
Harmonic oscillators
Aharonov-Bohm effect and macroscopic quantum phenomena

Chapter 3: Angular Momentum
Dates of lectures: Oct.23,25,30, Nov.1,6,8

Rotation and angular momentum.
Spin.
Eigenvalues and eigenstates of angular momentum
Addition of angular momenta

Chapter 4: Symmetry in Quantum Mechanics
Dates of lectures: Nov.13,15,20(mid-2),22,27,29

Discrete symmetries.
Parity
Time-reversal symmetry

Reviews Dates of lectures: Dec.4,6