Course Information

Course: Quantum Mechanics I (Physics 916)

Spring 2023, MWF 10:30 - 11:20am, JH 245

Instructor: Prof. Ilya I. Fabrikant, JH 310P, tel. 472-2774
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Official Office Hours: MWF 11:30am - 12:30pm

As a rule, the instructor will be available to students all weekdays from 9:30 am to 6 pm, but not before classes. Feel free to send an email, request a zoom session or come to the instructor's office with your questions.

Students with disabilities are encouraged to contact the instructor For a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln toprovide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

See http://go.unl.edu/coursepolicies for information on University-Wide Course Policies and Resources.

PREREQUISITES: Students should be aware that this course is NOT a duplication of undergraduate quantum mechanics or mathematical physics courses. Students should be familiar with undergraduate quantum mechanics (Phys 461 offered by this department or an equivalent)at the level allowing them to pass the preliminary exam. In addition, knowledge of the Classical Mechanics (Phys 911 level is preferred but undergrad 311 is sufficient) and Methods of Theoretical Physics (Phys 811) is REQUIRED.

Text: B. H. Bransden and C. J. Joachain, Quantum Mechanics, 2nd edition(Pearson Education, 2000)

Additional notes will be provided by the instructor on Canvas. Note that the notes are SUPPLEMENTARY, they don't duplicate the textbook, and are aimed to facilitate your understanding and mastering the material.

Recommended supplementary books:

J. J. Sakurai and J. Napolitano, Modern Quantum Mechanics, 2nd edition (Addison-Wesley, 1994, 2011)
(more focus on symmetries, more formalism; was used by the instructor in the past).

R. Shankar, Principles of Quantum Mechanics (Plenum Press, 1994, or a later print).
(Was used by the instructor in the past. Somewhat more formal with less applications
A good coverage of the Feynman path integral approach).

L. D. Landau and E. M. Lifshitz, Quantum Mechanics (More advanced topics).

C. Cohen-Tannoudji, B. Diu, and F. Laloe, Quantum Mechanics, vol.1
(This book was used by some instructors in the past. Contains more formalism).

Outline: (1) Quantum Dynamics and Hilbert Space
(2) Schroedinger equation in one dimension
(3) Schroedinger and Heisenberg pictures, path integrals
(4) Symmetries and conservation laws
(5) Theory of angular momentum and motion in a central potential

Homework: specific assignments and due dates will be posted on Canvas. The homework should be turned in in the HANDWRITTEN form on the due date by 5 p.m. If you prefer wring on Ipad, you can submit your work electronically by email.
Homework turned in after the due date loses three points per day. No homework is accepted 5 days after the due day. In case of illness or a personal emergency the new terms should be negotiated with the instructor. A conference trip or a work-related trip is not an excuse for turning in your assignment late.

Academic honesty: In doing homework you are allowed to discuss problems with each other, but you are NOT allowed to cooperate on writing down the solutions on the paper. There will be the ZERO-TOLERANCE POLICY on cheating. Cheating on exams or quizzes will result in the failing grade for the whole course.

Exams: four quizzes, one Midterm Exam and the Final Exam. All quizzes are closed-book. The exams are open-book, but closed-notes. No electronic equipment, including computers, phones, calculators etc., is allowed in quizzes and exams.

QUIZZES (in-class): 2/6, 2/24, 4/3, 4/24. It is the students responsibility to be in class when quizzes are given. If a student cannot be in class due to medical reasons, the instructor should be notified in advance, and arrangement should be made to take the quiz at another time.

MIDTERM EXAM: 3/9, 6:00-8:00pm (tentative)

FINAL EXAM: During the finals week (5/15-5/19) time TBD

Grades: midterm exam - 30%; final exam - 30%; quizzes - 20%; homework - 20%;
Extra credit can be earned by presenting advanced problems offered by the instructor.

Tentative grade scale

>96%	A+
90-96%	A
85-90	A-
80-85	B+
75-80	B
70-75	B-
65-70	C+
60-65	C
55-60	C-

Tentative schedule

1/23-1/27 Stern-Gerlach experiment. Hilbert space, state vectors, dynamical variables,operators, eigenstates.
(1.5, 5.1-5.3, lecture notes)

1/30-2/3 Commuting observables, unitary transformations, matrix representation of operators; harmonic oscillator in the Fock space (5.4-5.6)

2/6 -2/10 Wave function, wave packets. The uncertainty principle. The Schroedinger equation.(2.3-2.5, 3.1-3.2)

2/13-2/17 Schroedinger equation, expectation values. Ehrenfest theorem. Stationary states (3.3-3.5); degeneracies (lecture notes)

2/20-2/24 Energy eigenstates. Schroedinger equation in momentum space. The Green function and propagator.
(3.6-3.9 and lecture notes)

2/27-3/3 Free particle, potential step and potential barrier. The square well (4.1-4.6, lecture notes)

3/5 -3/10 Harmonic oscillator, linear potential, periodic potential. (4.7-4.8, lecture notes)
Problem solving session

3/13-3/18 SPRING BREAK

3/20-3/24 Time evolution, Heisenberg picture (5.7-5.8)

3/27-3/31 Path integrals, classical limit. Symmetry principles and conservation laws. (5.9-5.11 and lecture notes).

4/3 -4/7 Orbital angular momentum. Eigenvalues and eigenstates. (6.1-6.3). SO(3) symmetry and representations of the rotation operator (lecture notes)

4/10-4/14 Particle on a sphere. General angular momentum. Spin.

	(6.4-6.8). SU(2) symmetry (lecture notes).
4/17-4/21	Total angular momentum. 3-dim Schroedinger equation. (6.9-6.10,7.1-7.2)
4/24-4/28	Free particle and 3-d square well (7.3-7.4)
5/1 -5/5	Hydrogenic atom and isotropic oscillator (7.5-7.6). SO(4) symmetry of the Coulomb potential (lecture notes).
5/8 -5/12	Review and problem solving sessions