Syllabus

Quantum Theory I.

Phys-509, section 01.

Fall 2025.

Yurii Shylnov.

Sessions: Monday/Wednesday. 13:50 -15:05. Classroom: SB-106.

Instructor: Prof. Yurii Shylnov.

Office: PS-396.

Phone/ E-mail: Phone: (312) 567-3443. E-mail: shylnov@illinoistech.edu

Office hours: MTW 12:45-1:50pm or by appointment.

Textbooks:

1. Bipin Desai. Quantum Mechanics with Basic Field Theory. Cambridge University Press, 2009. 838 p. ISBN: 978-0521877602.

2. J. J. Sakurai, Jim Napolitano. Modern Quantum Mechanics. Third Edition. Cambridge University Press, 2021. 566 p. ISBN: 978-1108473224.

Preliminary Course Description:

1. Introduction. History of quantum theory.
2. One-dimensional Schrödinger equation. Tunneling, transmission coefficient, potential barriers, and wells, δ-potential.
3. Mathematical formalism of quantum mechanics (joined with the 501 course).
4. Two level system. Bloch sphere, basic quantum computer operations.
5. Harmonic oscillator.
6. Schrödinger equation and wave function in different representations.
7. Heisenberg Uncertainty principle. Measurements, observables, wave packets.
8. Schrödinger, Heisenberg, and interaction representations.
9. Multidimensional Schrödinger equation. Examples.
10. Spin. Pauli principle. Basic applications.
11. Charged particle in an external magnetic field.
12. Introduction into a path integral formalism (time permitting).
13. Schrödinger equation in spherical system of coordinates. Central force.
14. Hydrogen Atom (joined with the 501 course).
15. Aharonov-Bohm effect.

16. Perturbation theory. Both stationery and time-dependent cases.
17. Quasiclassical (WKB) approximation.
18. Atom. Electrons shells.
19. Hartree-Fock and Thomas-Fermi methods (time permitting).

Homework: You will receive your homework mostly every other week. All homework problems are to be done systematically and legibly. I am going to collect it and grade one problem selected randomly.

Project: It should be a mathematical problem of an acceptable level you find interesting and even exciting. Talk to me about your ideas ASAP. This is the key. After our conversation a title and abstract should be submitted by October 20th. A complete draft of a paper should be submitted by November 13th. A final version should be submitted by November 25th and discussed by December 4th. Please, take this part of our course seriously and do not procrastinate.

Tests: There will be three tests, on September 24th, October 29th, and December 1st. You are allowed to bring an equation sheet, A4 format, one side, handwritten by you personally to every test. **No final exams!**

There are no make-up tests, unless there are unexpected and well-documented emergency reasons and/or permission from the Dean of Students office. A make-up test will be slightly more complicated because a complete solution of the original test will be posted on Canvas.

Grading: Homework -20%, Tests - 60%, Project-20%.

Course Grade Determination: A 90-100%, B 80-89.9%, C 70-79.9%, D 60-69.9%, E below 60%.

Academic honesty: It is presumed that you will do your own work on the homework and tests. Discussing homework problems with others is encouraged but submitting work as your own which is copied or paraphrased from someone else is not permitted. Cheating includes, but not limited to, illegal collaboration, copying, using materials not permitted on tests, and aiding others on tests. Anyone found cheating will not be permitted to withdraw and will receive a grade of E for the course. Your academic dean will be informed and a statement will be placed in your permanent file. For more details, see the student handbook: https://www.iit.edu/student-affairs/student-handbook/fine-print/code-academic-honesty

Classroom environment Please, no cellular phones, iPods, iPads etc. in the class. I will be very much indebted to you if you do not eat, talk, text and so on in the classroom, because, believe it or not, it really distracts both me and your classmates. Of course, you are allowed to use your notebooks, tablets etc. to take notes but nothing else. The class format is going to be quite traditional. Lectures and discussions will take the most time.

Americans with Disabilities Act Policy Statement Reasonable accommodation will be made for students with documented disabilities. In order to receive accommodation, students must obtain a letter of accommodation from the Center for Disability Resources. The Center for Disability Resources (CDR) is located in 10 W. 35th St., Suite 3F3-1, phone: 312.567.5744 , e-mail: disabilities@illinoistech.edu .

Title IX Compliance

Title IX and our school policy prohibits discrimination on the basis of sex as well as all forms of sexual misconduct or harassment. I am always concerned about each and every student's well-being and ready to help. However, I am also required by the law to report any such incident to an Illinois Tech's Title IX coordinator. If you have experienced such an incident, please consult the following link for a list of resources available to you:

https://web.iit.edu/hea-compliance/sexual-harassment-and-misconduct-prevention/title-ix-illinois-tech/resources.

USEFUL DATES FROM THE ACADEMIC CALENDAR

	Courses Begin
September 1	Labor Day. No Classes.
September 5	Make up of Monday Classes
October 13, 14	Fall Break Day. No Classes.
October 17	Midterm Grades Due.
November 26-29	Thanksgiving Break. No Classes.
December 4	Last Day of Classes (Effective).
December 17	Final Grades are Due at Noon.