PHY 4604 Quantum Mechanics I

Section: U01

In Person

Fall Term 2024

Course Meeting Information

Classes are scheduled from 9:30 AM and 10:45 AM, Tuesdays, and Thursdays In CP 101.

Professor Information

Rajamani Narayanan

Contact: narayanr@fiu.edu

Office: ASTRO 204

Office Hours:

Tuesdays and Thursdays from 11 am to 1:30 pm

Additional Notes:

You can also schedule an appointment if the above times are not conveninent.

Melanie Frohlich (LA)

Contact: mfrol001@fiu.edu

Office Hours:

Two hours per week, Monday from 10 am to noon

Manuel Cortina (LA)

Contact: mcort086@fiu.edu

Office Hours:

Two hours per week, Wednesday from 9 am to 11 am

Ray Romero (LA)

Contact: rrome071@fiu.edu

Office Hours:

Two hours per week, Monday and Wednesday from 2 pm to 3 pm

Course Prerequisites

Prerequisites: PHY 3106, MAC 2313, MAP 2302

Course Description and Purpose

The students will learn the basics of quantum mechanics in the first semester of a one-year course.

Course Goals

To understand the principles of quantum mechanics

To be able to solve physics problems where quantum mechanics is experimenally relevant

To be able to write scientific notes in the scientific processing language, LaTeX, so that they become skilled in technical writing using LaTeX.

Student Learning Outcomes/Objectives

Student learning outcomes allow faculty to assess the level of proficiency in content knowledge and skills that their students acquire in a course.

If the objective meets a special designation, you will see the code after the objective:

University Core Curriculum: UCC
Gordon Rule Writing: GRW
Global Learning: GL
Civic Literacy: CL

- Students will be able to explain the foundations of wave mechanics, solve simple problems in wave mechanics, and use approximate techniques to solve problems of physical relevance

Expectations of the Course

This course will be one of the times in your undergraduate period where you will be evaluated for your writing skills. The aim of the course is to obtain a holistic experience of the subject and not just solve homework problems at the end-of-the-chapter. Your class notes have to maintained electronically using LaTeX, the scientific processing language used widely in physics and mathematics. No other word processing language can be used.

Assignments

There will be four in-class tests. These tests will be open-book and you are allowed to use your notes while taking the test. You are expected to submit your class notes for evaluation just before you take each in-class test. The material for each test will be clearly stated at least one week before the test.

Test dates and times

9/19/24 -- 9:30 am to 10:45 am CP 101 (material covered in the first three weeks of classes)

10/24/24 -- 9:30 am to 10:45 am CP 101 (material covered up to the lecture on 10/17/24)

11/21/24 -- 9:30 am to 10:45 am CP 101 (material covered up to the lecture on 11/14/24)

12/10/24 -- 9:45 am to 11:45 am CP 101 (cumulative exam)

There is no make-up for submission of notes. Make-up tests can only be given if there is sufficient medical documentation. All make-up tests will be administered during the final exam week (no exceptions).

Grading

50%: Four submissions of class notes (equally weighted).

50%: Four in-class tests (equally weighted).

Final grade will be determined from the distribution of students' points in the class and the class average.

Textbook and Course Materials

No text book is required

Required/Recommended: N/A

Authors: N/A

Publisher: N/A

Publication Date: N/A

Copyright Date: N/A

ISBN 10: N/A

ISBN 13: N/A

Panther Book Pack

FIU has implemented the Panther Book Pack rental program, which provides your required print and digital course materials at a flat rate of $20 per undergraduate credit hour. When you registered for your classes this session, you were notified via email of the required course materials that are included in the Panther Book Pack. The Panther Book Pack program applies to all undergraduate credit hours per academic session. I recommend that you review the pricing for all materials across your classes this session compared to the Panther Book Pack flat rate. If the Panther Book Pack is not your best option, you may opt-out up to three days after the add/drop deadline. You may opt back into the Panther Book Pack up to three days after the add/drop deadline. If you do not opt out of the Panther Book Pack rental program, you will be charged $20 per credit hour and the course materials will be reserved for you for the undergraduate courses for which you are registered. For more details, visit onestop.fiu.edu/bookpack.

Other Course Materials and Open Educational Resources (OER)

There are many good textbooks for quantum mechanics. I decided to take the approach of using online lecture notes that are freely available. There are many such notes and here is a partial list (the levels vary).

MIT Open Courseware

Professor Tong's lectures

Professor Greensite's lecture notes

Professor Chew's lecture notes

My aim is for my students to make-up their own lecture notes based on my lectures in class. If you are very happy with your notes at the end of the academic year, I suggest you post your notes online. Here are examples of three such notes from 2023-24

Adolfo Menendez Rua

Ray Romero

Melanie Frohlich

The above notes should serve as references. Formatting your notes by directly copying from one of the above is considered plagiarism. You should also keep in mind there could be errors in these notes and you are solely responsible for all errors in your notes that you submit for class evaluation.

Course Communication

Communication in this course will take place directly via student's fiu email. I will respond to all correspondences within 24 hours.

Policies

As a member of the FIU community, you are expected to be knowledgeable about the behavioral expectations set forth in the FIU Student Conduct and Honor Code.

In addition, the FIU Policies and Procedures Library website serves as the official repository for university-wide policies and procedures.

Technical Requirements and Skills

One of the greatest barriers to student success is a lack of basic computer literacy. By computer literacy, we mean being able to manage and organize computer files efficiently and learning to use your computer's operating system and software quickly and easily.

Privacy Policy Statements for some of our Partners and Vendors

- Canvas
- Microsoft
- Adobe
- YouTube
- LinkedIn

- ProctorU
- HonorLock
- Turnitin
- OpenStax
- Zoom
- Respondus LockDown Browser

Accessibility and Accommodation

The Disability Resource Center collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive, and sustainable. The DRC provides FIU students with disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact the Center at 305-348-3532 or visit them at the Graham Center GC 190.

For additional assistance please contact FIU's Disability Resource Center.

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Academic Integrity

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and honestly demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the University's educational mission. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Conduct and Honor Code.

Academic Misconduct includes:

Cheating

- The unauthorized use of any materials, information, study aids, or assistance from another person on any academic assignment or exercise unless explicitly authorized by the course Instructor;
- Assisting another student in the unauthorized use of any materials, information, or study aids, unless explicitly authorized by the Instructor; and
- Having a substitute complete any academic assignment or completing an academic assignment for someone else, either paid or unpaid;

Plagiarism

- The deliberate use and appropriation of another work without any indication of the source and the representation of such work as the Student's own.
- Assisting another student in the deliberate use and appropriation of another's work without any indication of the source and the representation of such work as the student's own.

Learn more about Student Conduct and Academic Integrity.

Panthers Care & Counseling and Psychological Services (CAPS)

If you are looking for help for yourself or a fellow classmate, Panthers Care encourages you to express any concerns you may come across as it relates to any personal behavior concerns or worries you have, for the classmate's well-being or yours; you are encouraged to share your concerns with FIU's Panthers Care website.

Counseling and Psychological Services (CAPS) offers free and confidential help for anxiety, depression, stress, and other concerns that life brings. Professional counselors are available for same-day appointments. Don't wait to call (305) 348-2277 to set up a time to talk or visit the online self-help portal.

Core Principles of this Course

This course will serve all students, encouraging collaboration by preparing students to value the differences in others. We appreciate the multiplicity of the lived experiences and perspectives of all students. We are committed to the ongoing education of our students and their open participation within the course.

Copyright

The following conduct is prohibited by the Student Conduct and Honor Code. A lack of familiarity with University policy is not a defense to a violation of this Code. Unless specifically noted, the intent is not a required element to establish a policy violation. The

following conduct violation or any attempt to violate the Code will be used in charging all Students or Student Organizations;

Section 5 | Conduct Violations - g. Computer Misuse

- vii. Unauthorized distribution or downloading of copyrighted materials, including but not limited to, unauthorized peer-to-peer file sharing. This is a violation whether the user is using their own personal computer or the University's information technology system for unauthorized distributions.

Copyright Statement: The materials and content in this course are provided solely for student use during the course. Course materials may not be shared outside of the course or with any third party without the explicit permission of the instructor or content publisher. Visit FIU Library's Copyright Lib Guide to learn more about copyright law and restrictions.

Additional Resources:

- Student Conduct and Honor Code
- Digital Millennium Copyright Act Policy
- FIU - Copyright Guidance for Students
- FIU Library's Copyright Lib Guide

Course Awards

None.

PHY 4605 Quantum Mechanics II

Section: U01

In Person

Spring Term 2025

Course Meeting Information

Class Meeting Times	
Day:	TTh
Time:	9:30 AM - 10:45 AM
Location:	CP 117

Professor Information

Rajamani Narayanan

Contact: narayanr@fiu.edu

Office Hours:

11am to 1pm on Tuesdays and Thursdays

Course Prerequisites

Prerequisite: PHY4604

Course Description and Purpose

The students will continue to learn the basics of quantum mechanics in the second semester of a one-year course.

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Course Goals

To understand the principles of quantum mechanics

To be able to solve physics problems where quantum mechanics is experimenally relevant

To be able to write scientific notes in the scientific processing language, LaTeX, so that they become skilled in technical writing using LaTeX.

This is the second semester of a one-year undergraduate course in quantum mechanics. We will move on to problems in two and three dimensions. We will use the harmonic oscillator as an example to address the role of rotational symmetry in two and three dimensions. Angular momentum operators will be introduced and commutation relations with the Hamiltonian operator will be discussed to understand the role of symmetry and degeneracies of eigenvalues. This will lead to an extension discussion of the algebra of angular momentum operators and angular momentum quantum numbers. The problem of the Hydrogen atom will be discussed in complete detail. We will continue to explore more aspects of angular momentum including spin, addition of angular momenta and irreducible tensors.

Not all problems in quantum mechanics can be solved exactly. To that end we will develop some approximation techniques. Systematic perturbation theory will be discussed in details including time-independent and time-dependent perturbation theory.

If time permits, we will discuss additional topics such as scattering theory, path integral formalism, Dirac equation, quantum entanglement etc.

Student Learning Outcomes/Objectives

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- explain the foundations of wave mechanics
- solve simple problems in wave mechanics
- use approximate techniques to solve problems of physical relevance

Expectations of the Course

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Assignments

There are no homework problems for this course. You are expected to submit your class notes for evaluation just before you take each in-class test.

There will be three in-class tests. You may use your own class notes while taking the test. No other material is allowed except a calculator. All answers to questions should be answered in full, and you may not refer to locations in your notes as responses to the questions. The test responses have to be handwritten.

Test dates and times

2/6/25 -- 9:30 am to 10:45 am -- CP 117 (material covered till 1/30/25)

3/13/25 -- 9:30 am to 10:45 am -- CP 117 (material covered till 3/6/25)

4/17/25 -- 9:30 am to 10:45 am -- CP 117 (material covered till 4/10/25)

There is no make-up for submission of notes. If you miss a test due to illness or other emergencies, and you can provide a valid documentation, an average of the tests you took will make up the grade for the missed test.

Grading

50%: Three submissions of class notes (equally weighted).

50%: Three in-class tests (equally weighted).

Final grade will be determined from the distribution of students' points in the class and the class average.

Textbook and Course Materials

No textbooks required for purchase

Required/Recommended: N/A

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Core Principles of this Course

This course will serve to embrace the diversity and inclusivity found within Florida International University. We appreciate and respect diversity, equality, equity, cooperativeness, community, and sustainability within our online courses. We are committed to the ongoing education of our students and their participation within the course regardless of gender, ethnicity, age, sexual orientation, geographical location, religion, and disability. We strive in encouraging collaboration by preparing our students to value the differences in others. At the core of our intentions is the encouragement of acceptance and appreciation of differences within our student population and community.

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