

# Physics 420: Quantum Mechanics I

West Chester University  
Fall 2022

## Syllabus

Updated: August 22, 2022

### INSTRUCTOR

Dr. Morrison (*he/him/his*)

SECC 359

✉ [imorrison@wcupa.edu](mailto:imorrison@wcupa.edu)

☎ +1 (610) 436-3297

### OFFICE HOURS

- Monday 12:30-1:50 pm ET
- Monday 3:00-4:00 pm ET
- Wednesday 12:30-1:50 pm ET
- Friday 12:30-1:50 pm ET

### COURSE DETAILS

Activity	Day	Time	Location
Class:	Tuesday, Thursday	11:00 am - 12:15 pm ET	SECC 209
Final exam:	Tuesday, 13 December	10:30 am - 12:30 pm ET	SECC 209

For Zoom class meetings (not office hours), use this [Zoom link](#) and the password **phy420**. You must use your WCUPA Zoom account (i.e., the one linked to your University email address).

### COURSE DESCRIPTION

This course is an introductory quantum mechanics course. The following fundamental topics will be covered: the Schrodinger equation, solutions to systems with stationary states (potential step, potential well, potential barrier, and harmonic oscillator), an abstract view of quantum mechanics (Dirac notation, operator methods), the hydrogen atom, angular momentum, and spin.

### PREREQUISITES

Satisfactory completion of PHY 240, PHY 300, and MAT 315 or MAT 343 or PHY 370.

### TIME COMMITMENT

PHY420 is a 3-credit hour course presented at the senior level. For many students, PHY 420 is the most challenging lecture course in the B.S. in Physics curriculum. Expect to commit 6-9 hours to reading, assignments, and studying outside of class time each week.

## COURSE SCHEDULE

The **Course Schedule**, which provides lecture topics, readings, assignments deadlines, and exam dates, is available on the course D2L homepage.

## STUDENT LEARNING OUTCOMES

This course contributes to the following program student learning outcomes:

- *Knowledge and understanding of the concepts and principles of physics (Outcome A).* Upon successful completion this course, students will demonstrate competence solving problems involving the topics listed in the [Course description](#).

Course material is introduced through lecture and textbook reading. Weekly homework assignments provide students with training and practice. Student competence is primarily assessed through in-class exams and the final exam.

- *Effective Communication (Outcome C).* Upon successful completion of this course, students will demonstrate the ability to formulate complete written solutions to quantum mechanics problems.

Weekly homework assignments serve as both a practice and assessment tool for this outcome.

## COURSE MATERIALS

1. **Required textbook:** The course textbook is *Quantum Mechanics: A Paradigms Approach*, by David McIntyre (Pearson, 2012. ISBN: 9780321765796). You are expected to have access to this text. New versions of the textbook are for sale at the [WCU campus store](#); you will find less expensive options elsewhere.
2. **Recommended textbook:** *Introduction to Quantum Mechanics*, by David J. Griffiths and Darrell F. Schroeter (Cambridge UP, 2018. ISBN: 9781107189638). This is another standard introductory textbook on the subject and is the textbook used in recent iterations of this course.
3. **Scientific or graphing calculator:** For exams you may use a stand-alone scientific or graphing calculator with no internet or wireless communication abilities. You may not use a watch, mobile phone, or computer.

## ASSESSMENT

This course follows the official WCU scale for grades:

Grade	Quality Points	Percentage	Interpretation
A	4.00	93-100	Excellent
A–	3.67	90-92	
B+	3.33	87-89	Superior
B	3.00	83-86	
B–	2.67	80-82	
C+	2.33	77-79	Average
C	2.00	73-76	
C–	1.67	70-72	
D+	1.33	67-69	Below Average
D	1.00	63-66	
D–	0.67	60-62	
F	0.00	<60	Failure

Refer to the [WCU Undergraduate Catalog](#) for description of NG (No Grade), W, Z, and other grades.

Elements of the course will contribute to the course grade as follows:

Percent	Category
24%	Homework (12 highest assignment scores, each worth 2%)
50%	Exams (2 exams, each worth 25%)
26%	Final exam

**24% Homework:** Weekly homework assignments are posted on the course D2L site and are due **at 11:59 pm ET on Fridays** – see the **Course Schedule** for details. The twelve highest assignment scores will each contribute 2% of your course grade. Homework is submitted via [Crowdmark](#).

Homework should be prepared following the [Homework guidelines](#) below. Homework is assessed for both completeness and accuracy. Homework may be “spot checked”, i.e., not all aspects of an assignment may be examined. Solutions to homework problems are posted on D2L after the assignment deadline.

**50% Exams:** There will be two, 2-hour-long exams offered during the semester. Each exam contributes 25% of your course grade. Exams are offered during the weeks listed on the **Course Schedule** at mutually agreeable times.

Exams are “closed book”: the only aids allowed are a stand-alone calculator and an equation sheet. Due to the nature of the curriculum exams are effectively cumulative.

Exam scores may be scaled (“curved”) to conform to a standard distribution of grades. Failure to take an exam results in a 0 score.

26% **Final exam:** The comprehensive final exam is scheduled for the time listed on page 1. The final exam time and date are arranged by the Registrar’s Office and can change. You should plan to be available the entire Final Exam Period.

The final exam is “closed book” in the same manner as exams. Final exam scores may be scaled (“curved”) to conform to a standard distribution of grades. Failure to take the exam results in a 0 score.

Although unlikely, I reserve the right to alter the assessment scheme in order to accommodate for unforeseen circumstances or to better serve the learning objectives of the course. Due dates of homework as well as the dates of exams may change.

## HOMEWORK GUIDELINES

Your goal is to formulate **complete solutions** to homework problems. A complete solution includes relevant figures, states assumptions, provides explanations, and shows all mathematical steps and checks. When writing up your homework solutions, follow these guidelines:

- **Format:** You will submit your work to [Crowdmark](#). Your solutions should be hand-written with black or blue writing on clean, white, letter-size paper. Colored pens and graph paper are okay for drawing figures. If you make a mistake, simply cross it out – no white out or scribbling. Alternatively, you may use a tablet computer. No typesetting (i.e., do not use a word processor, equation editor, or LaTeX).
- **No original scratch work:** Submitted work should never be your first attempt at a problem.
- **Organization:** Solutions should be labeled by problem number and should be in order.
- **Expository text:** Include sufficient prose to guide the reader (a.k.a., someone like you) through your solution.
- **Math:** Include all necessary math steps, as well as checks of your work.
- **Cite references:** List any collaborators, and cite any references you use, aside from the course documents.

Of course, not all problems require a lengthy exposition. Use your judgment.

## LATE OR MISSED WORK

If you suspect that you will not be able to meet a course deadline you should notify me in advance so that we can discuss possible resolutions. The default policies on late and missed work are as follows:

- **Other courses:** No other course has priority over this course. The obligations of your other courses do not excuse you from meeting obligations for this course.
- **Homework:** Late work may receive a reduced score, and may not be considered. No work is accepted after solutions are posted on D2L.
- **Exams:** Exams are offered at pre-arranged time(s) that are compatible with every student's WCU schedule. Exams are not offered at alternate times, unless an exam conflicts with an event which is recognized by the WCU [Excused Absences Policy](#)– see [Excused absences](#). Failure to take an exam results in a 0 score.
- **Final exam:** This course follows the WCU [Final Exam Policy](#). The time and date of the final exam are set by the Registrar and can change. The final exam is not offered at alternate times. There is no final exam “exemption.”

## ELECTRONIC DEVICES

**In general, the only personal electronic devices that may be used in class are tablet-style computers which use a stylus.** Other electronic devices such as mobile phones, smart watches, and laptop computers are not conducive to the kind of note-taking necessary for this course. Their use distracts the user and students around them. There may be some classes in which we use simulations or numerics; for those classes you are welcome to use a laptop.

## ATTENDANCE

Attendance is not a graded item in this course.

If you miss class then it is your responsibility to make up the missed learning opportunity by reviewing course materials on your own. Missing class does not excuse you from completing other aspects of the course on time.

## EXCUSED ABSENCES

This course adheres to the WCU [Excused Absences Policy](#). If you are unable to perform an aspect of the course due to a conflict recognized by this policy (which includes University-Sanctioned Events) you must notify me in advance so that we can make arrangements.

## ACCOMMODATION

If you require accommodation for any aspect of the course you must notify me in advance so that we can make arrangements. Depending on the circumstances, you may need to provide documentation.

- **OSSD:** If you have an ongoing medical condition which effects your ability to meet the course expectations then you should register with the [Office of Services for Students with Disabilities](#) (OSSD). **To receive accommodation please submit your OSSD Letter of Accommodation to me via email ([imorrison@wcupa.edu](mailto:imorrison@wcupa.edu)).**
- **Health/wellness conditions:** If you seek accommodation for a medical condition which causes you to miss at least three consecutive school days, then contact the [Student Assistance](#). I can offer accommodation based upon the advice of this office.
- **Personal emergencies:** Rarely, a personal emergency can arise which prevents a student from meeting course expectations. In such a rare circumstance I am happy to work with the student in order to make appropriate arrangements. I may require documentation which verifies the emergency. [Student Assistance](#) can serve as a confidential liaison to verify the emergency.

## IF YOU GET SICK

If you get sick then several of the policies above are relevant. Briefly:

- Obviously, if you are sick with a contagious disease then do not attend class or office hours.
- You are expected to make up for missed class by reviewing course material on your own. Once you are healthy you are welcome to attend office hours; however, I cannot summarize an entire class during an office hours visit.
- You are welcome to request an extension on homework assignments in advance of the deadline.
- **If an illness will cause you to miss an exam you must notify me in advance so that we can arrange accommodation.**

## TECHNOLOGY

- **D2L:** Course materials are maintained on the course D2L site. You are responsible for regularly checking the course D2L site. I may not announce in class changes to course content on D2L. As with all technology, D2L can have glitches and service outages. For this reason, check D2L frequently and do not leave tasks to the last minute.

- **Communication:** I use the D2L announcement tool to make class-wide announcements. I use email for individual correspondence and for time-sensitive class-wide communications. Except in the event of a technical failure or an emergency, I will only use university email (mine and yours) to correspond.
- **Email:** Emails should be written with appropriate language and etiquette.
- **Zoom:** This course may use [Zoom](#) for virtual class meetings or office hours. You are expected have basic competence using [Zoom](#). You may wish to consult the [IST Zoom documentation](#). You are welcome to blur your background, or use a virtual background, so long as the image is not inappropriate or distracting. Here are [instructions for setting up a virtual background](#), as well as [WCU-themed virtual background images](#).
- **Recording:** Students do not have permission to record class meetings, whether held in person or virtually. Such recording is restricted by privacy laws, including Pennsylvania Wiretap Law and FERPA. See [Accommodation](#) and [Intellectual property](#).

## ACADEMIC INTEGRITY

Students are expected to follow all WCU rules and guidelines on academic integrity as described in the [WCU Undergraduate Catalog](#). Here are a few relevant issues for this class:

- **Online platform:** D2L, [Zoom](#), and [Crowdmark](#) are extensions of the classroom and as such all WCU rules regarding student behavior apply on these platforms. Do not violate the copyrights of these sources. Do not misrepresent your identity on these platforms, either by impersonating someone else or by allowing another person to impersonate you.
- **Collaboration:** Students are encouraged to study together and collaborate on assignments. However, you should go through the process of solving each homework problem yourself. Please list collaborators on your homework. Submitting solutions which you have not yourself obtained is fraud.
- **Learning resources:** Students are welcome to use additional resources beyond those provided by the instructor to help them master course material. Examples of learning resources include textbooks, instructional videos, informational websites, and private tutors. Please list any reference you use (aside from course materials) on your homework.

“Learning resources” does not include any source of solutions to assigned problems, whether found online or elsewhere. “Learning resources” also does not include so-called tutoring websites which offer solutions to problems upon request. These websites include (but are not limited to) Course Hero, Chegg, and Clutch Prep. Using these sites could lead to a violation of

WCU rules on academic integrity. If you are unsure about whether the use of a website or product is legitimate, ask me before using.

- **Copyright violations:** Course content contains intellectual property which may be protected by state and federal copyright law. **Students do not have permission to share course content with any person, website, or company.** Sharing includes posting content on a website or in a public place, or storing content on a computer that is used by others. See [Intellectual property](#) below.
- **Online activity logs:** Be aware that the course platforms D2L, [Crowdmark](#), and [Zoom](#) provide records of user activity to the instructor and the University. In the event of a suspected academic integrity violation, this data will be examined and may serve as evidence of misconduct.

Students who violate WCU rules of academic integrity may receive an [Academic Integrity Violation Report](#), and may receive a failing grade (F) in the course.

## INTELLECTUAL PROPERTY

The instructor utilizes copyrighted materials under the “Freedom and Innovation Revitalizing the United States Entrepreneurship Act of 2007” (Fair Use Act). Apart from such copyrighted materials, all other intellectual property associated with this course is owned and copyrighted by the instructor, including, but not limited to, lectures, course discussions, course notes, slides, assessment instruments such as exams, and supplementary materials posted or provided to students authored by the instructor. No recording, copying, storage in a retrieval system, or dissemination in any form by any means of the intellectual property of the instructor, in whole or in part, is permitted without prior written permission of the instructor. When such permission is granted, it must specify the utilization of the intellectual property and all such permissions and waivers shall terminate on the last day of the semester in which this course is held.



# Statements Common to All WCU Undergraduate Syllabi



## ACADEMIC & PERSONAL INTEGRITY

It is the responsibility of each student to adhere to the university's standards for academic integrity. Violations of academic integrity include any act that violates the rights of another student in academic work, that involves misrepresentation of your own work, or that disrupts the instruction of the course. Other violations include (but are not limited to): cheating on assignments or examinations; plagiarizing, which means copying any part of another's work and/or using ideas of another and presenting them as one's own without giving proper credit to the source; selling, purchasing, or exchanging of term papers; falsifying of information; and using your own work from one class to fulfill the assignment for another class without significant modification. Proof of academic misconduct can result in the automatic failure and removal from this course. For questions regarding Academic Integrity, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to the Department Undergraduate Handbook, the Undergraduate Catalog, the Ram's Eye View, and the University website at [www.wcupa.edu](http://www.wcupa.edu).

## STUDENTS WITH DISABILITIES

If you have a disability that requires accommodations under the Americans with Disabilities Act (ADA), please present your letter of accommodations and meet with me as soon as possible so that I can support your success in an informed manner. Accommodations cannot be granted retroactively. If you would like to know more about West Chester University's Services for Students with Disabilities (OSSD), please visit them at 223 Lawrence Center. Their phone number is 610-436-2564, their fax number is 610-436-2600, their email address is [ossd@wcupa.edu](mailto:ossd@wcupa.edu), and their website is at <https://www.wcupa.edu/universityCollege/ossd/>. In an effort to assist students who either receive or may believe they are entitled to receive accommodations under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973, the University has appointed a student advocate to be a contact for students who have questions regarding the provision of their accommodations or their right to accommodations. The advocate will assist any student who may have questions regarding these rights. The Director for Equity and Compliance/Title IX Coordinator has been designated in this role. Students who need assistance with their rights to accommodations should contact them at 610-436-2433.

## EXCUSED ABSENCES POLICY

Students are advised to carefully read and comply with the excused absences policy, including absences for university-sanctioned events, contained in the WCU Undergraduate Catalog. In particular, please note that the "responsibility for meeting academic requirements rests with the student," that this policy does not excuse students from completing required academic work, and that professors can require a "fair alternative" to attendance on those days that students must be absent from class in order to participate in a University-Sanctioned Event.

## REPORTING INCIDENTS OF SEXUAL VIOLENCE

West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to comply with the requirements of Title IX of the Education Amendments of 1972 and the University's commitment to offering supportive measures in accordance with the new regulations issued under Title IX, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. **Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University Protection of Minors Policy.** Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: <https://www.wcupa.edu/admin/diversityEquityInclusion/sexualMisconduct/default.aspx>

## INCLUSIVE LEARNING ENVIRONMENT AND ANTI-RACIST STATEMENT

Diversity, equity, and inclusion are central to West Chester University's mission as reflected in our [Mission Statement](#), [Values Statement](#), [Vision Statement](#) and [Strategic Plan: Pathways to Student Success](#). We disavow racism and all actions that silence, threaten, or degrade historically marginalized groups in the U.S. We acknowledge that all members of this learning community may experience harm stemming from forms of oppression including but not limited to classism, ableism, heterosexism, sexism, Islamophobia, anti-Semitism, and xenophobia, and recognize that these forms of oppression are compounded by racism. Our core commitment as an institution of higher education shapes our expectation for behavior within this learning community, which represents diverse individual beliefs, backgrounds, and experiences. Courteous and respectful behavior, interactions, and responses are expected from all members of the University. We must work together to make this a safe and productive learning environment for everyone. Part of this work is recognizing how race and other aspects of who we are shape our beliefs and our

experiences as individuals. It is not enough to condemn acts of racism. For real, sustainable change, we must stand together as a diverse coalition against racism and oppression of any form, anywhere, at any time.

Resources for education and action are available through WCU's [Office for Diversity, Equity, and Inclusion](#) (ODEI), DEI committees within departments or colleges, the student [ombudsperson](#), and centers on campus committed to doing this work (e.g., [Dowdy Multicultural Center](#), [Center for Women and Gender Equity](#), and the [Center for Trans and Queer Advocacy](#)). Guidance on how to report incidents of discrimination and harassment is available at the University's [Office of Diversity, Equity and Inclusion](#).

#### **EMERGENCY PREPAREDNESS**

All students are encouraged to sign up for the University's free WCU ALERT service, which delivers official WCU emergency text messages directly to your cell phone. For more information, visit [www.wcupa.edu/wcualert](http://www.wcupa.edu/wcualert). To report an emergency, call the Department of Public Safety at 610-436-3311.

#### **ELECTRONIC MAIL POLICY**

It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.