

PHYS 361: Introduction to Quantum Computing

Fall 2026

Syllabus

Instructor

Prof. Sebastian Deffner
Physics, Rm. 311
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Time and Place

MoWe 1:00pm – 2:15pm
Janet & Walter Sondheim, Rm. 406

Office hours

Mo 9:00am – 11:00am
Physics, Rm. 311

Literature

- **Quantum Computing Unveiled**
Wan, ISBN-13: 978-1-009-65607-8
- **Mathematics for Physics and Physicists**
Appel, ISBN-13: 978-0-691-13102-3
- **Introduction to Quantum Information Science**
Vedral, ISBN-13: 978-0-19-921570-6
- **Protecting Information**
Loepp and Wootters, ISBN-13: 978-0-521-53476-5
- **Quantum Computation and Quantum Information**
Nielsen and Chuang, ISBN-13: 978-1-107-00217-3

Scope

Starting only from elementary Linear Algebra and Probability theory, this course offers an entry point into Quantum Computing. By the end of this course, students will be familiar with the basics of Classical Information Theory, Quantum Information Theory, simple Quantum Algorithms, and Quantum Error Correction.

Dates

- First day of class: August 24, 2026
- Last day of class: December 9, 2026
- First midterm exam: September 30, 2026
- Second midterm exam: November 4, 2026
- Final exam: tbd

Course Objectives

This course will provide a general introduction to the elements of Quantum Computing. It will discuss key concepts and methods, introduce the relevant terminology, and develop the main ideas of theoretical understanding. You will solve quantitative and complex problems and develop rigorous derivations. As an advanced course, special emphasis will be put on deep understanding and mathematically thorough reasoning.

At the end of the course, you should understand and be able to apply the following concepts:

- What is quantum computing? History and why do we care?
- Classical and quantum information theory (basics)
- Quantum measurements, quantum correlations, and quantum entanglement
- Quantum gates and circuits
- Simple quantum algorithms, such as Grover's and Simon's algorithm

Course Format

PHYS 361 is designed as a traditional lecture course. However, individual reading will play an important role. Only the most important principles and connections will be discussed in lecture, the rest will be left for reading.

Feel free to ask questions during lecture, whether you have difficulty with a concept, notice an error, or want to hear more details about an aspect of the material. It is important that we do not move on until all the important issues are settled.

Homework

There will be a homework assignment every week. The assignments will be posted on Blackboard, and submission is due the following day indicated at 1:00pm (before class). A homework assignment will consist of two parts:

- Four more complex problems that have to be worked out and written up in detail at home as a usual homework assignment and submitted. These problems will be graded to 4 points each. It will be expected that the submitted problems be written up in a clear, legible, and organized fashion, complete with appropriate verbal comments and figures, very much like examples in the textbook.

- A reading assignment complementary to the material discussed in class. The homework assignments will contain two questions about the reading material, which will amount to another 4 points.

You are allowed, in fact, encouraged, to form study groups and discuss the material and homework questions with each other. However, at the end, the homework solution must be your own work, not a group product. I will give no credit for obvious copies. After all, you are left to your own devices at the tests and in real life. Learn from each other, but be able to work on your own.

Late homework will not be accepted (no exceptions). Homework will be submitted at the beginning of class on the date it is due. Only submissions in OUR OWN HANDWRITING and in person will be accepted.

Exams

There will be two midterm exams during the semester and one final exam.

Grades

Your grade will be determined according to the following distribution of points:

1. Homework assignments (12): 20 points each; 240 points in total.
2. First midterm exam: 25 points, weighted by a factor of 7; 175 points in total.
3. Second midterm exam: 25 points, weighted by a factor of 7; 175 points in total.
4. Final exam: 50 points, weighted by a factor of 7; 350 points in total.

This adds up to a possible total of 940 points. Approximately, A will be given above 85%, B for at least 70%, C for at least 55%, and D for at least 40%.

Full credit requires complete and correct solutions. I also understand that even with a few mistakes, your work may have value. Thus, you can get a good grade in spite of missing a few details or making an occasional mistake in the calculation.

“Incomplete” is given only in exceptional cases. To be considered for an “I”, you must have taken at least the midterm exam, submitted 8 homework solutions, and have C or better standing at the time of incapacitation.

Academic Integrity

”By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC’s scholarly community in which everyone’s academic work and behavior are held to the highest standards of honesty. Cheating on a test could result in disciplinary action that may include, but is not limited to, suspension or dismissal.” More on the requirements of academic integrity can be found at <http://www.umbc.edu/gradschool/procedures/integrity.html>

Applied to this course, a proven case of misconduct during a test or a blatant copy or plagiarism of a homework solution “earns” zero on the assignment in question. A second offense will result in failing the course.

All work must be entirely your own. **The use of generative AI tools is NOT allowed at any stage of the course, including brainstorming, experiments, coding, research, writing, or revision. If you have any questions, feel free to reach out to me. The use of AI tools will be treated as an academic integrity issue. This includes the use of SMART GLASSES!**

Accessibility and Disability Accommodations, Guidance and Resources

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

- SDS email: disAbility@umbc.edu
- SDS phone: 410-455-2459

If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination

UMBC Policy in addition to federal and state law (to include Title IX) prohibits discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment, or related retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources. The Title IX Coordinator can be reached at ecr@umbc.edu or 410-455-1717.

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in making a report, please use the Online Reporting/Referral Form. Please note that, if you report anonymously, the University's ability to respond will be limited.

Notice that Faculty and Teaching Assistants are Mandated Reporters with Mandatory Reporting Obligations.

All faculty members and teaching assistants are considered Mandated Reporters, per UMBC's *Interim Policy on Sex Discrimination, Sex-Based Harassment, and Sexual Misconduct*. Faculty and teaching assistants therefore required to report all known information regarding alleged conduct that may be a violation of the Policy to the Title IX Coordinator, even if a student discloses an experience that occurred before attending UMBC and/or an incident that only involves people not affiliated with UMBC. Reports are required regardless of the amount of detail provided and even in instances where support has already been offered or received.

While faculty members want to encourage you to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report past and present sexual harassment, sexual assault, domestic and dating violence, stalking, and gender discrimination that is shared with them to the Title IX Coordinator so that the University can inform students of their rights, resources, and support. While you are encouraged to do so, you are not obligated to respond to outreach conducted as a result of a report to the Title IX Coordinator.

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of Confidential Resources available to support you:

- Retriever Integrated Health (Main Campus): 410-455-2472; Monday – Friday 8:30 a.m. – 5 p.m.; For After-Hours Support, Call 988.
- Center for Counseling and Well-Being (Shady Grove Campus): 301-738-6273; Monday-Thursday 10:00a.m. – 7:00 p.m. and Friday 10:00 a.m. – 2:00 p.m. (virtual) Online Appointment Request Form
- Pastoral Counseling via The Gathering Space for Spiritual Well-Being: 410-455-6795; i3b@umbc.edu; Monday – Friday 8:00 a.m. – 10:00 p.m.
- Women, Gender, and Equity Center (open to students of all genders): 410-455-2714; womenscenter@umbc.edu; Monday – Thursday 9:30 a.m. – 5:00 p.m. and Friday 10:00 a.m. – 4 p.m.

Please note that Maryland law and UMBC policy require that faculty report all disclosures or suspicions of child abuse or neglect to the Department of Social Services and/or the police even if the person who experienced the abuse or neglect is now over 18.

Pregnant and Parenting Students

UMBC's *Interim Policy on Sex Discrimination, Sex-Based Harassment, and Sexual Misconduct* expressly prohibits all forms of discrimination and harassment on the basis of sex, including pregnancy. Resources for pregnant, parenting and breastfeeding students are available through the University's Office of Equity and Civil Rights. Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and ensure ongoing access to their academic program with respect to a leave of absence – returning following leave, or any other accommodation that may be needed related to pregnancy, childbirth, adoption, breastfeeding, and/or the early months of parenting.

In addition, students who are pregnant and have an impairment related to their pregnancy that qualifies as disability under the ADA may be entitled to accommodations through the Office of Student Disability Services.