



STUDENT HANDBOOK

Introduction to
Quantum
Computing

2023 - 2024

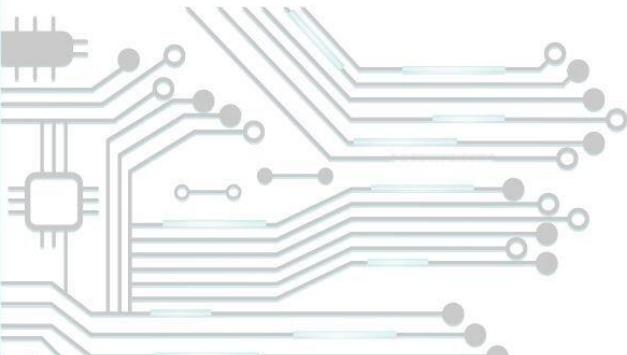


TABLE OF CONTENTS

(Use the links to navigate this document!)

Who We Are

[Qubit by Qubit \(QxQ\)](#)

[Accreditation](#)

[Contacting Qubit by Qubit](#)

About the Course

[Description](#)

[Objectives](#)

[Course Outline](#)

[Calendar](#)

[Lead Instructors: Connie & Derrick](#)

Weekly Requirements

[Course components](#)

[Weekly Announcement](#)

[Grades](#)

[Threshold](#)

[Components of Your Final Grade](#)

[QxQ Principles for Grading:](#)

[Absence Policy](#)

[Late Homework Policy](#)

[Group Work & Plagiarism Policy](#)

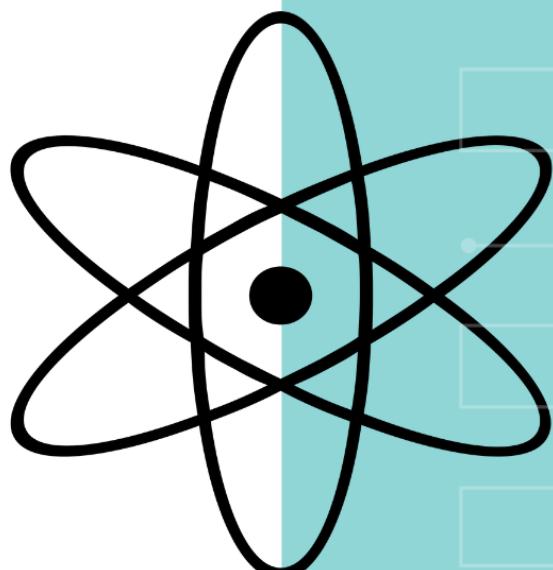
[Note-taking & Lecture Recordings](#)

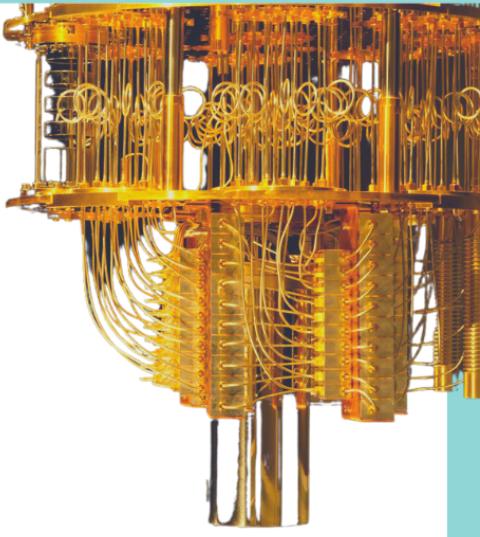
[Copyright and Sharing Materials Policy](#)

Course Technology

[Zoom \(video conferencing\)](#)

[Canvas](#)





Petitioning Your School for Credit

University of California A-G
appropriate course

Student Safety and Privacy

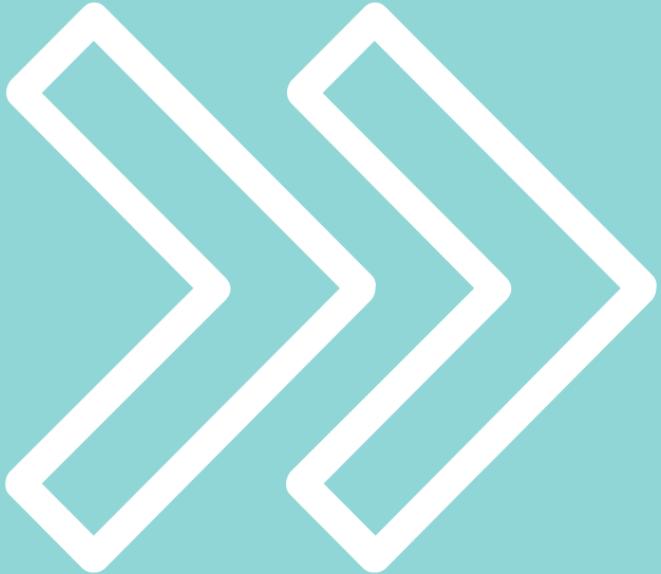
Code of Conduct
Data Privacy Policy
Community Norms: Engaged, Supportive, Inclusive.

Student Resources

Homework Review Session
Office Hours
Help Form

Withdrawing From the Course

Certificate Information



This handbook
will be your guide
for any and all
questions you may
have this year!³

WHO WE ARE

Qubit by Qubit (QxQ)

Qubit by Qubit is a first-of-its kind, nonprofit initiative dedicated to making quantum computing accessible to early learners of quantum computing: K-16 students. In partnership with leading quantum experts, we're bringing quantum computing out of the PhD lab and into classrooms around the world through age-appropriate, engaging, and innovative programs. To learn more, please visit: <https://www.qubitbyqubit.org/>.

QxQ is an initiative of The Coding School (TCS), a 501(c)(3) international tech education nonprofit dedicated to preparing students with the technical skills for the future of work. To learn more about TCS, visit: the-cs.org.

Accreditation

The Coding School is fully accredited by the Accrediting Commission for Schools, Western Association of Schools and Colleges. You can find more details about the Accrediting Commission and what this means by visiting WASC's [website](#). If your school has questions about providing credit, they may contact us for additional information or contact WASC directly.



Contacting Qubit by Qubit

If you have questions throughout the course, please first read this document. Many common questions are answered here. In addition, please check our [Frequently Asked Questions document](#), which is regularly updated based on student questions.

If your question still was not answered, please email: student@qubitbyqubit.org

hi, we're
Qubit by Qubit⁴



ABOUT THE COURSE



Description

Qubit by Qubit's *Introduction to Quantum Computing* is a cutting-edge course designed to introduce high school students to the exciting world of quantum computing. Quantum is the next frontier of computing technology, and will impact fields such as healthcare, finance, and cybersecurity. We want students to be at the forefront of this computing revolution. In this course, students will learn concepts that many students do not hear about until well into their undergraduate or even graduate education.

Students do not need a background in quantum computing or computer science to take this course - the only prerequisite is having taken a geometry or trigonometry course. We will teach them everything they need to know, from basic linear algebra and probability, to Python coding basics. We will also spend time exploring the “weird” physics properties of quantum mechanics that make quantum computers so powerful. By the end of this course, students will be able to code quantum gates and circuits, implement quantum algorithms, and even run code on a real quantum computer.

At Qubit by Qubit, our mission is to train the future diverse quantum workforce. Our hope is that this course will be an empowering, exciting experience for students learning about a technology that will impact the world. We focus on creating a supportive and inclusive learning environment for students from all backgrounds.

Prerequisite: Successful completion of a geometry or trigonometry course. Students are *not* required to have a background in computer science.

Objectives

Our mission is to train the future diverse quantum workforce.

- Introduce students to the field of quantum computing
- Develop foundational skills, including math, computer science, and physics, necessary to pursue quantum computing

- Prepare students with tangible, real-world skills
- Deepen understanding of quantum applications
- Learn about career opportunities in quantum
- Increase diversity in the field
- Introduce students to industry and academic leaders in quantum
- Form a global cohort of future quantum leaders



Course Outline

This outline is subject to change.

Semester 1 Topics

- What is quantum computing?
- Classical and quantum computing stacks
- Introduction to quantum mechanics
- Qubits, quantum gates, quantum circuits
- Quantum measurements
- Programming quantum circuits with Qiskit
- Math for quantum states, gates, and measurements
- Introduction to quantum algorithms and protocols
- Quantum Key Distribution

Semester 2 Topics

- Multi-qubit circuits and the CNOT gate
- Entanglement and the Bell states
- Superdense coding
- Grover's Algorithm
- Near-term, hybrid algorithms
- Quantum chemistry and finance
- Quantum hardware
- Experimental metrics and implementation



Calendar

This course runs from **September 24, 2023 - April 28, 2024**. Students will also have two extended breaks following the U.S. school calendar.

Course Orientation & First Lecture	September 24, 2023 (Sunday)
Fall Break	November 19 - 25, 2023
Winter Break	December 16, 2023 - January 13, 2024
Spring Break	March 10 - 16, 2024
Graduation	April 28, 2024 (Sunday)



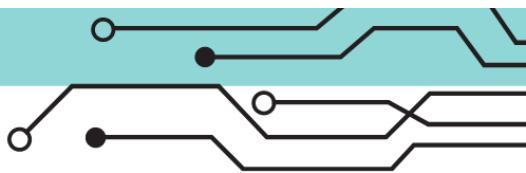
Lead Instructor: Connie Hsueh, PhD

Dr. Connie Hsueh is a Congressional Science Fellow with the American Institute of Physics. She completed her PhD in Applied Physics at Stanford in 2023 with a research focus on semiconductor physics and nanoscience. She also holds advanced degrees from Caltech (B.S.) and University of Cambridge (MPhil). Outside of quantum technology, she is interested in science policy, scientific ethics, traveling, and water polo.



Lead Instructor: Derrick Boone, PhD

Dr. Derrick Boone Jr. has a varied career journey to date including: military service, physics research, consulting, and work at a biotech startup. He holds degrees in Physics from MIT (B.S.), Johns Hopkins University (M.S.), and Stanford University (PhD). Today, he teaches mathematics full-time at an all-girls high school in California. He is excited to help train the next generation of technology leaders. Hopkins University (M.S.), and Stanford University (PhD). Today, he teaches mathematics full-time at an all-girls high school in California. He is excited to help train the next generation of technology leaders.



Course Components

Each week, there are three requirements:

1. **Lecture (Sunday, 12:30-2:00pm ET (UTC-4)):** Every Sunday, there will be a 1.5-hour lecture (via Zoom). We highly encourage students to attend the lecture live, but recordings will be available for those unable to attend.
2. **Lab (many time options):** Each week, students attend a one 1-hour lab section (via Zoom). During the lab, a Teaching Assistant (TA) will introduce new material, go over students' questions, and practice problems similar to the homework. Live lab attendance is required and counts towards students' final grades. **Note: Students will select their lab times in the week before class.**
3. **Homework (weekly, due by 11:59pm ET the following Sunday):** Each week, there will be a homework assignment related to the lecture. The homework, on average, should take students around 1 hour to complete. Homework will be released following the Sunday lecture, and they will be required to submit the homework by 11:59pm ET the following Sunday. Solutions will be available after the homework deadline has passed. Late homework assignments will receive a 3% per day late penalty.

Weekly Announcement

Each Monday, the QxQ team will post an announcement with important course reminders on Canvas. Students are expected to read the announcement weekly. We recommend [setting up notifications](#) so that you receive an email when a new announcement is posted.

Grades

Threshold

This course is Pass/Fail, and 60% is a passing grade. If you complete the homework and show up to lectures and labs, you will pass the course. Students will get a grade for each semester. Whether you pass the course will be based on the average of your two semester percentages.

Note for Partner School Students: If your school has partnered with us, please check with them as your school's grading policy for the course may be different from QxQ's default policy (for example: some schools will be giving students letter grades).

Components of Your Final Grade

Homework <ul style="list-style-type: none">Submitted via Canvas.Students can submit the homework assignment as many times as they would like prior to the deadline to attempt a higher score.	50%
---	-----

<ul style="list-style-type: none"> Course Final Projects will be included in the homework score. We will drop students' 3 lowest homework scores, with the exception of the final project each semester. Late penalty: 3% per day, maximum 50% penalty. 	
Lab Attendance <ul style="list-style-type: none"> Attendance at weekly labs is required. We understand that students may have occasional commitments that prevent them from attending their regular lab section. Thus, students are granted 2 absences per semester with no effect on their grade. Canvas will excuse these absences automatically. There is no need for you to do anything or contact QxQ. All additional absences will count against your grade. Students will need to submit their lab attendance within 2 hours of their lab session. 	40%
Complete required course evaluation <ul style="list-style-type: none"> Occasionally, we will have students complete course evaluations and surveys. These are graded based on completion (in other words, if you complete the evaluation prior to the deadline, you will receive full credit). 	10%

QxQ Principles for Grading:

- This class is intended to be an empowering, not stressful, experience for students, and grades are simply a way to ensure students are accountable and engage weekly with the course material. It is not meant to test or compare students.
- We know students come to this course from incredibly diverse backgrounds, with varying exposure to STEM. We will do our very best to accommodate these differences.
- QxQ recognizes that remote learning presents unique challenges. Likewise, we know that some students may have barriers to accessing stable internet, lack stable housing, or face other challenges that impede their learning. Increasing diversity in STEM is a core part of our mission, and we will work with students to the greatest extent possible.
- Our grading policy is flexible and subject to change based on student performance.
- Most importantly, we want our students to succeed!

Absence Policy

We encourage students to attend the weekly lecture live. If they are unable to attend the lecture, they must watch the recording instead (posted on Canvas within 24 hours).

Live lab attendance is required and counts as part of students' final grades. All students will receive 2 free absences per semester (in other words, they can miss 2 labs with no effect on their grade). We ask that you notify us and plan to complete an alternate lab assignment via lab recording. Each additional absence will have a negative impact on students' grades. If there are extenuating circumstances (for example: a medical emergency), please email us and we will do our best to work with you.

Late Homework Policy

Late homework submissions are accepted. However, late submissions are subject to a 3% per day late penalty. The maximum late penalty is 50%, and you will still be able to submit work.

Group Work & Plagiarism Policy

We encourage students to work together to learn course material. We believe in a collaborative and supportive community where students learn from one another. Students are encouraged to form study groups and use online tools, like Piazza, to complete assignments. However, plagiarism will not be tolerated. Students should not share answers to assignments with one another and should not copy from their classmates. Plagiarism violations will be taken seriously and may be grounds for removal from the course.

Note-taking & Lecture Recordings

Students are strongly encouraged to take notes during lecture and lab. Lecture and lab slides will not be shared. Each week, the recording of the lecture will be posted for students to view if they cannot attend live. Special events will be recorded if guest speakers consent to be recorded. Recordings will not be available once the course is over.

Copyright and Sharing Materials Policy

All curriculum for this course, including but not limited to lecture slides and recordings, lab materials, and homework assignments are the copyrighted property of The Coding School. You are not allowed to circulate the materials to students outside of the course.

Course Technology

For this course, you will use several different technology platforms. Each is outlined below.

Zoom (video conferencing)

Weekly lecture link:

https://us06web.zoom.us/webinar/register/WN_3UF7ubR5SqOeTz3NGVISxw#/registration

Lab links: Lab links will be posted on Canvas during Week 2.

The video conferencing platform that we will use for this course is Zoom. We will use Zoom for all lectures, labs, and special events.

Google CoLab

Review the  [2023 TCS Google Colab Guide](#) to set up your coding environment.

Canvas

Canvas will be available to students the Week of October 15th.

Discord (optional)

Discord will be available to students the Week of October 15th.

Petitioning Your School for Credit

High school students participating in Introduction to Quantum Computing may petition their high school to receive academic credit for completing the course. In the past, students have received credit as an elective course, independent study, or International Baccalaureate CAS project.

Note: Not all schools are able to grant credit for completion of outside courses. Qubit by Qubit cannot guarantee that your school will be willing to provide you with credit.

If you want to petition your school to receive credit, we recommend that you follow these steps:

1. **Contact your school:** Talk to a school official about obtaining school credit for outside courses. If you are unsure who to talk to, we recommend starting with your guidance counselor.
2. Bring this [informational packet for schools](#) with you. It contains most of the course information that is commonly requested by high schools.
3. If you or your school needs additional information from us, please contact our program staff at student@qubitbyqubit.org.
4. If your school agrees to provide you with course credit, please fill out the [course credit form](#) to let us know what documentation you will need from us.
5. Here are some additional questions you should discuss with your school:
 - a. In order to get course credit, do I need to take this course for a letter grade? Or can I take it pass/fail?
 - b. How and when should course grades be sent to you? Can I give you a QxQ grade report, or does the QxQ office need to send it to you directly?

Note for California students:

University of California A-G Appropriate Course

This course, “Introduction to Quantum Computing” is UC A-G appropriate as a “G” elective course. As an online course provider, The Coding School is listed in the [UC A-G directory](#). For more information, visit <https://hs-articulation.ucop.edu/guide/>.

Student Safety and Privacy

We take student safety and privacy seriously. All instructional staff have undergone background checks and participated in sexual harassment training. Instructors and TAs have all been sourced from personal and professional networks and come recommended.

Code of Conduct & Reporting a Violation

All students are required to agree to the Code of Conduct as a condition of enrolling in the program. **To read our comprehensive Code of Conduct, please click [here](#).**

Qubit by Qubit takes Code of Conduct violations seriously. Depending on the severity of the concern, violations may result in immediate dismissal from the course.

To report a Code of Conduct violation, please fill out the form [here](#). For urgent matters, call our office or email us with the subject line 'URGENT' at student@qubitbyqubit.org.

Data Privacy Policy

To view The Coding School's data privacy policy, click [here](#). To summarize, The Coding School does not sell, share, or distribute participants' data to third parties.

Community Norms: Engaged, Supportive, Inclusive.

- The Coding School (TCS) is committed to fostering a respectful, empowering learning environment for all students, instructors, staff, and visitors.
- We welcome students from all backgrounds, including those who are new to STEM. We are all on this learning journey together. Every student is on a level playing field, and we can all learn from one another. Students are not in competition with one another and should be supportive, not competitive.
- A core part of our mission is to make the future quantum workforce diverse and inclusive. We actively promote diversity in our courses and want all students to celebrate the different backgrounds and experiences of our students.
- Curiosity, effort, and engagement are valued over perfection. Our main ask is that you are engaged and do your best. Quantum computing is difficult, and we do not expect students to master it on the first - or even second or third - try.
- We ask students to be present, engaged, and supportive of one another.

Student Resources

Feel like you're falling behind in the course, or have specific questions about the material? These resources are for you!

Homework Review Session

Weekly: TBD |

Each week, QxQ staff will host a 1-hour homework review session. This is a large-group session open to all students in the course. The staff member who leads the homework session will pick a selection of problems from that week's homework and walk students through solving them. The link to the homework review sessions will be posted on Canvas and added here when available.

Office Hours

If students need additional help with their homework, they will have the opportunity to sign up to attend optional office hours with QxQ tutors. This will be an opportunity for students to have their questions answered individually or in a small group. The link to office hours will be posted on Canvas and added here when available.

Weekly:TBD

Frequently Asked Questions

[23 - 24 Intro to Quantum FAQ's](#)

Help Form

Need assistance logging into Canvas or other course technologies after the first week of class? Submit the [Help Form](#) and our support staff will be happy to help within 2 business days. Note: the help form is *not* the place to ask content-related questions. Please post those questions on Canvas.

Withdrawing from the Course

Withdrawal Deadline: October 20th, 2023

We're sad to see you go, but we understand that sometimes life happens and you need to withdraw from the course.

Before deciding to withdraw, please get in touch with us at student@qubitbyqubit.org. We'd love to see if there is anything we can do to help you finish the course successfully!

To withdraw, submit the [Help Form](#) and select "I want to withdraw from the course."

Certificate Information

At the end of the course (either Semester 1 or Semester 1 & 2), all students who pass with a grade of 60% or higher will receive a certificate of completion. Certificates will be sent to students via email after the semester ends. Certificates will be shared electronically - hard copies will not be provided by Qubit by Qubit.