**EE539B: Introduction to Quantum Hardware**
**Winter, 2025**
Prof: Maxwell Parsons (mfpars@uw.edu)
TA: Kevin Wu (ypwk@uw.edu)

**Professor Office Hours:** 6 pm - 7 pm Mondays **NOTIFY by 5 pm on the day if you plan to attend**
**TA Office Hours:** 6 pm - 7 pm Tuesdays **NOTIFY by 5 pm on the day if you plan to attend**
**Class Hours:** Th 6-9:50pm
**Class Room:** ECE 003

**Lab Room:** ECE B023 (lower basement)
**Extra Lab Hours:** TBD, if needed

# Course Description

This course is designed to provide an introduction to hardware used in quantum information sciences (quantum computing, quantum networks, and sensing). After reviewing some mathematical preliminaries, we will cover the classical description of polarization of light, quantum states and operators, quantum measurement, spin-1/2 (qubit) systems, and entanglement. This course will use a combination of lectures, numerical exercises, and hands-on laboratory equipment in the Quantum Technologies Training and Testbed (QT3) Laboratory to teach these concepts. Laboratories will explore the entanglement of photons and using polarization to transmit quantum information, control of solid-state qubits using radiofrequency pulses, and ion trapping.

# Required Materials

- **Textbook:** *Quantum Mechanics: Theory and Experiment,* M. Beck, Oxford University Press (2012) (available as an ebook. from the UW library).
- **Computer:** For accessing Canvas in class. We will take periodic breaks in lecture for quick knowledge checks requiring an internet connection.

# Prerequisites/Corequisites

Students should have previously studied linear algebra (vector spaces, inner products, eigenvalues) and have familiarity with complex numbers (e.g., the phasor description of electromagnetic waves). These topics do not need to be fresh in your mind, as important mathematical concepts will be reviewed at the beginning of the course.

Students should have working knowledge of Python for completing numerical exercises and for controlling laboratory equipment.

# Course Structure

### *Class Structure*

Class meetings will generally begin with a lecture component followed by a period dedicated to either numerical exercises to explore the concepts from the lecture or to completing the physical labs. Students will have the opportunity to engage with at least two of the four labs over the course. In the final two weeks of the course, we will replace the lab component with an open-ended project, which will either involve extending one of the physical labs or a theoretical/numerical study as students prefer.

### *Grading*

- **40% Problem Sets:** There will be 4 problem sets, each worth 10% of the grade. Students are welcome to work together on problem sets but must provide their own solutions with thorough explanations and list collaborators on each problem set.
- **30% Lab Reports:** Students will be broken up into 3-4 groups, depending on enrollment, and complete two of the four available labs. For each lab, each group will submit one lab report.
- **20% Final Projects:** The deliverable for final projects will either be a written report or a presentation, to be decided at the beginning of the course.
- **10% Lecture Participation:** Lectures will be broken up by brief quizzes to measure how well material is being absorbed. These will be graded based on participation and not on whether students arrive at the correct answer.

## Academic Integrity

The University takes academic integrity very seriously. Behaving with integrity is part of our responsibility to our shared learning community. If you're uncertain about whether something constitutes academic misconduct, ask me. Acts of academic misconduct may include but are not limited to:

- **Cheating:** Working together and exchanging ideas on problem sets is encouraged, but copying solutions or providing solutions to copy is cheating. Students must write the names of collaborators on each problem set.
- **Plagiarism:** Representing the work of others as your own without giving appropriate credit to the original authors.

Students shall adhere to the University of Washington's Student Code of Conduct. Concerns about behaviors prohibited by the Student Conduct Code will be referred for investigation and adjudication by the College of Engineering Dean's Office and the University's Office of Community Standards and Student Conduct.

## Access and Accommodations

Your experience in this class is important to me. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so we can discuss how they will be implemented in this course.

If you have not yet established services through DRS but have a temporary health condition or permanent disability that requires accommodations (conditions include but are not limited to mental health, attention-related, learning, vision, hearing, physical, or health impacts), contact DRS directly to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Contact DRS at disability.uw.edu.

## Diversity and Inclusion

We are committed to creating an inclusive environment in which all students are respected and valued. We will not tolerate disrespect or discrimination on the basis of age, ability, ethnicity, race, gender identity or expression, marital or parental status, military or veteran status, national origin, political affiliation, religious or spiritual beliefs, sex, sexual orientation, socioeconomic status, or other visible or non-visible differences. We will endeavor to refer to each other by our preferred names and pronouns—for instance, Professor Parsons, or Max (since this is an advanced graduate class), uses he/him pronouns.

## Religious Accommodations

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form