



### **CMPE 497 FALL 2024 – QUANTUM COMPUTING**

**Section 1, 3 units, on-ground, ScN 220, Mon Wed 12:30-1:45 pm**

**Instructor:** Dr. Alex Sumarsono, [alex.sumarsono@csueastbay.edu](mailto:alex.sumarsono@csueastbay.edu), SF-515, 408-622-1471

**Office Hours:** Mon & Wed 5:00 – 6:30 pm (via zoom) or by appointment

- Zoom link: <https://csueb.zoom.us/j/83534352540>

**Prerequisites:** MATH 215 (Linear Algebra), CS 301 (Data Structures and Algorithms).

**Required Textbook:** Thomas G. Wong, *Introduction to Classical and Quantum Computing*, Rooted Grove, 2022.

- The author has made this book available free of charge. Visit his website:  
<https://www.thomaswong.net/>

#### **Recommended Textbooks:**

- *Quantum Computing: A Gentle Introduction* by Eleanor Rieffel, Wolfgang Polak.
- *Quantum Computation and Quantum Information* by Michael Nielson, Isaac Chuang.

#### **Course Description**

This course provides a broad introduction to quantum computing, covering principles, techniques, and selected applications. Topics include quantum operations, gates and circuits, superposition and entanglement, superdense coding and teleportation, and various quantum algorithms such as Deutsch-Jozsa, Shor's and Grover's algorithms. The primary objective is to equip students with fundamental concepts of quantum computing and enable them to gain practical proficiency in quantum programming.

#### **Learning Outcomes**

- Understand the principles of quantum mechanics and their relevance to quantum computing.
- Gain knowledge of quantum gates, circuits and algorithms.
- Acquire practical skills in implementing and simulating quantum circuits on real quantum computers using quantum programming languages and tools.
- Develop an awareness of the challenges and advancements in quantum hardware technologies.

## Grading Policy

The final grade will be determined based on the following:

- Class participation = 10% (randomly selected for grading, lowest grade dropped)
- Homework = 20% (randomly selected for grading, lowest grade dropped)
- Labs = 30% (randomly selected for grading, lowest grade dropped)
- Exams = 40% (2 midterms and 1 final, take home, all equally weighted)

Grading schemas

95 – 100 : A	77 – 79 : C+
90 – 94 : A-	74 – 76 : C
87 – 89 : B+	70 – 73 : C-
84 – 86 : B	60 – 69 : D
80 – 83 : B-	0 – 59 : F

Class participation includes attendance (taken randomly) and exercises.

No make-up assignments or exams will be given unless approved by the instructor in advance.

Late submissions will be accepted with a 50% penalty on the maximum score if submitted either before the solutions are posted/discussed or within three (3) days after the due date, whichever occurs first.

Pay attention to due dates and instructions as outlined in the **Weekly Schedule**.

- Link to class google drive:  
[https://drive.google.com/drive/folders/1kM58nYxoikzSUITIA88IUTrxdrEFxGQ1?usp=drive\\_link](https://drive.google.com/drive/folders/1kM58nYxoikzSUITIA88IUTrxdrEFxGQ1?usp=drive_link)

Study Tips

- Attend lecture. Be sure you understand what is discussed in class.
- Read the relevant section(s) in the textbook and complete the corresponding homework problems as soon as possible. You don't want to fall behind!
- Consider collaborating with your classmates.

## Other Policies

- By enrolling in this class the student agrees to uphold the standards of academic integrity described in the catalog and on the [Academic Policies web page](#).
- If you have a documented disability and wish to discuss academic accommodations, or if you would need assistance in the event of an emergency evacuation, please contact me as soon as possible. Students with disabilities needing accommodation should speak with [Accessibility Services](#).
- California State University, East Bay is committed to being a safe and caring community. Your appropriate response in the event of an emergency can help save lives. Information on what to do in an emergency situation (earthquake, electrical outage, fire, extreme heat, severe storm, hazardous

materials, terrorist attack) may be found at [Risk Management web pages](#). Please be familiar with these procedures. Information on this page is updated as required. Please review the information on a regular basis.

- A Note on Discrimination, Harassment, and Retaliation (DHR) California State University East Bay is committed to a community free from sexual assault and violence. Title IX and CSU policy prohibit discrimination, harassment and retaliation, including Sex Discrimination, Sexual Harassment or Sexual Violence. CSUEB encourages anyone experiencing such behavior to report their concerns immediately. CSUEB has both confidential and non-confidential resources and reporting options available to you. As a faculty member, I am required to report all incidents and thus cannot promise confidentiality. I must provide our Title IX coordinator and or the DHR Administrator with relevant details such as the names of those involved in an incident. For confidential services, contact the Confidential Advocate at 510-885-3700 or go to the Student Health and Counseling Center. For 24-hour crisis services call the Bay Area Women Against Rape (BAWAR) hotline at 510-845-7273. For more information about policies and resources or reporting options, please visit the following websites: <https://www.csueastbay.edu/diversity/title-ix/>
- The University is committed to maintaining a safe and healthy living and learning environment for students, faculty, and staff. Each member of the campus community should choose behaviors that contribute toward this end. [View the Standards for Student Conduct](#).
- To access student services offered at Cal State East Bay, please visit [MyCompass](#) for information on academic advising, tutoring, financial aid, the library, the health center, technology support, career counseling, campus life, equity programs and more.
- If you wish to appeal your course grade at the end of the semester or have other academic concerns related to a course, please visit the [Grade Appeals and Academic Grievances](#).

## Tentative Schedule

	<b>Week of</b>	<b>Topic</b>
1	Aug 19	Introduction, superposition, complex number
2	Aug 26	Measurement, Bloch sphere, quantum gates
3	Sep 2	LABOR DAY – no class (Monday 9/2/24) Quantum circuits
4	Sep 9	Matrix operations, quantum states, inner products
5	Sep 16	Quantum gates
6	Sep 23	Outer products, states and measurement
7	Sep 30	Entanglement, quantum gates
8	Oct 7	Measurement MIDTERM 1 – take home (Wednesday 10/9/24)
9	Oct 14	Bell inequalities, superdense coding
10	Oct 21	Teleportation, quantum key distribution
11	Oct 28	Circuit and query, parity and Deutsch's algorithm
12	Nov 4	Berstein Vazirani algorithm, Grover's algorithm
13	Nov 11	VETERANS DAY – no class (Monday 11/11/24), QFT
14	Nov 18	Phase estimation MIDTERM 2 – take home (Wednesday 11/20/24)
15	Nov 25	FALL RECESS– no class
16	Dec 2	Modulo exponentiation, Shor's algorithm
		FINAL EXAM – take home, Monday 12/9/24 (12:45 – 2:00 pm)

Course schedule & topics may be changed at the discretion of the instructor.