

ECE 480-A7: Introduction to Quantum Computing

Instructor: Kaveh Rahbardar Mojaver

Objectives

ECE 480-A7 course aims to equip students with a comprehensive understanding of quantum mechanics' foundational principles and their application to quantum computing. By the end of the course, participants will master the core concepts of quantum computing, clearly distinguishing them from classical computing methods. Through hands-on mini projects, students will gain practical experience by implementing a quantum algorithm on cloud-accessible quantum computers, including Quix and IBM, preparing them for further exploration and innovation in the field of quantum computing.

Prerequisites

MATH 369 - Linear Algebra I

ECE 102 - Digital Circuit Logic

Detailed Course Outline (Week-by-Week)

Following is a tentative course outline. It is subject to change depending on progress in class instruction and the mini projects.

Week	Topics
1	Introduction to Quantum Computing, History of Quantum Computing, How Quantum Computing Differs from Classical Computing
2	Overview of Linear Algebra, Matrix Exponents, Matrix Decompositions, Rotation Operators, Invertibility
3	Quantum States, Notation for Multiparticle States, Entanglement
4	Quantum Gates
5	Universal Quantum Algorithms
6	Leading Qubit Modalities, Qubit Robustness
7	Integrated Photonics for Quantum Applications-1
8	Integrated Photonics for Quantum Applications-2
9	Programmable Photonics and Quantum Computers

10	Experimental Quantum Computing Platforms 1: Quix Photonic Quantum Computer
11	Trapped-Ion Quantum Computers and Superconducting Qubit Quantum Computers
12	Experimental Quantum Computing Platforms 2: IBM Quantum Computer
13	Quantum Computing and Industry Perspectives
14	Quantum Algorithms and Their Potential Speed-Up
15	Quantum Communication and Encryption, Quantum Key Distribution
16	Review - Mini Project Presentations

Textbook

M. A. Nielsen and I. L. Chuang, Quantum Computation and Quantum Information: 10th Anniversary Edition., Cambridge University Press, 2010.

Grading Policy

Assignments 30%
 Midterm exam 20%
 Final exam 20%
 Mini projects 30%

Policy for Late Homework Submission

Homework assignments that are turned in after the specified due date without a university sanctioned justification will result in a 10% per day score deduction.

Office hour

By appointment. Please send an email to Mojaver@colostate.edu

Resources:

This link (<https://col.st/2FA2g>) or the QR code below provides policies relevant to the courses and resources to help with various challenges students may encounter.

