EEC289L: Quantum Information Technologies

4 units - Winter 2022

Prerequisite: required – EEC189U (Quantum Mechanics for Engineers), MAT 022A (Linear Algebra), desired - any class in PHY 009 series

Grading: Letter; Class Participation 10%, Midterm 30%, Homework 30%, Final Project 30%

Instructor: Prof. Marina Radulaski (mradulaski@ucdavis.edu

Course communication: Canvas and Slack

Course Description:

This course is aimed at graduate students with interest in quantum technologies who have a solid background in linear algebra. The course learning goals aim for students to:

- Become familiar with the unintuitive concepts of quantum mechanics such as the superposition, entanglement, and the no-cloning theorem,
- Command the basics of the Dirac notation (i.e. the mathematical formalism of quantum information),
- Learn the concepts of quantum computing, quantum communication and quantum sensing,
- Understand the operating principles of some of the most prevalent physical implementations of quantum information systems,
- Learn to program in Qiskit open-source quantum computing software development framework,
- Develop interdisciplinary communication and presentation skills.

The lectures will incorporate active learning and student discussions, while the weekly homework will help solidify the understanding of concepts and provide practice in quantum programming. The midterm exam will assess the mastery of the technical material, while the group project will provide an opportunity to delve into a topic of interest, practice teamwork, science communication and presentation skills. The final presentation will consist of a short video and an in-class Q&A session.

Textbook/reading:

1. Nielsen, Michael A., and Isaac L. Chuang. "Quantum Computation and Quantum Information (10th Anniv. Version)." (2010).
2. Abraham Asfaw, Luciano Bello, Yael Ben-Haim, Sergey Bravyi, Lauren Capelluto, Almudena Carrera Vazquez, Jack Ceroni, Jay Gambetta, Shelly Garion, Leron Gil, Salvador De La Puente Gonzalez, David McKay, Zlatko Minev, Paul Nation, Anna Phan, Arthur Rattew, Javad Shabani,

John Smolin, Kristan Temme, Madeleine Tod, James Wootton. "Learn Quantum Computation using Qiskit." (August 2019). Retrieved from http://community.qiskit.org/textbook

3. Scientific publications in the field of quantum information technologies

Grading

Participation (10%): Participation in class activities carry 0.5% of the grade/class. Additionally, beginning of the course assessment and the mid-quarter evaluation participation carry 0.5% each.

Homework (30%): There will be 8 homework sets, each carrying 3.75% of the grade. Homework is uploaded to Canvas in pdf form. Late homework can be submitted up to 7 days after the deadline for half of the score.

Midterm (30%): The midterm will be a take-home exam with strict adherence to the honor code.

Final group project (30%): The final project will be evaluated based on the elements of the video presentation and the responses in the Q&A session related to the project topic.

The grades will be distributed as follows:

A [93% ,100%], A- [90%,93%), B+ [87%,90%), B [83%,87%), B- [80%,83%), C+ [77%,80%), C [73%,77%), C- [70%,73%), D+ [67%,70%), D [63%,67%), D- [60%,63%), F [0%, 60%)

A+ can be awarded in exceptional circumstances where students have gone above and beyond expectation.

Disability accommodation

If you believe you need an accommodation for a disability that might interfere with your ability to participate in class, submit assignments, or take an exam, please contact the UC Davis Student Disability Center (SDC). Please submit SDC-obtained documentation to the course instructor during office hours or before/after lecture during the first two weeks of the course.