Course: EE 599-001 / EE 699-010
Title: (Parallel and) Quantum Computing

Term: Spring 2026
Credit hours: 3
Meeting days/time/location: Tuesday & Thursday, 12:30-1:45PM,
                                 309 Robotics & Manufacturing Building

Instructor Information
Name: Professor Henry (Hank) Dietz
Email: hankd@engr.uky.edu (please put "QC" in subject line)
Office building and room number: 203 Davis Marksbury Building
Office phone: (859) 257 4701
Office hours: Schedule & live office camera at http://aggregate.org/hankd
Preferred method of communication: email

Course Description
This course presents a computer engineering view of quantum computing, with emphasis on system design and operation, not the quantum phenomena used. The goal of the course is to provide students with an understanding of what quantum computers can and cannot do, quantum gates and basic algorithms used, how quantum computing systems are architected as computational accelerators, and how quantum-inspired methods can be employed without using quantum phenomena.

Course Prerequisites
Digital logic (CPE282 or EE280) and some programming

Required Materials
Various materials for the course will be provided, primarily via canvas or the course website, https://aggregate.org/QC/ . There is no textbook. Materials will be posted or linked at canvas and/or the course website.

Associated Expenses
Rather than requiring software to be installed on personal computers or in-person use physical lab facilities, Verilog and simulation software are provided in forms that allow work to be done using a web browser interface that gives access to software running on machines in 108 Marksbury (Dietz's research lab). Students are expected to have personal systems able to use this web browser interface. You are warned that, at this writing, the course URLs are `http:` sites; unfortunately, the latest Chrome browser by default automatically changes `http:` to `https:`

unless you have added the site to a safe exceptions list. Students also need access to a computer that can pack their project files into either a `tar` or `zip` archive containing the files for submission.

Activities Outside of Regular Class Meetings

None are planned.

If any regular class meeting is not held in person for any reason, the material *usually* will be made available online via a recorded presentation, perhaps with the option of live Zoom attendance, rather than by scheduling in-person make-up sessions.

Skill and Technology Requirements

Students are expected to have some programming experience and exposure to digital logic design, and they are generally expected to be computer literate. Students need access to a system that allows them to use various WWW form interfaces provided for the projects and other course materials. There is also portable, open-source, software provided that they can install and use on their own computers as alternatives to some of the WWW form interfaces.

For technical assistance, contact ITS Customer Services 24/7 at 859-218-HELP (4357) for urgent needs. For non-urgent matters, visit the ITS web page at https://its.uky.edu/ *or submit a:* [Customer Services Assistance Request form.](#)

Student Learning Outcomes

After completing this course, a student will be able to:

- Create and optimize circuit designs using adiabatic logic and quantum gates.
- Explain the basic features of quantum computation and their significance, including superposition, entanglement, measurement, and interference.
- Explain how quantum computing can be used to augment classic computers as attached processors, and what quantum computers cannot do by themselves (including the implications of decoherence and errors).
- Explain how various quantum algorithms could outperform classic algorithms -- and why quantum superiority has been so elusive.
- Give examples of how quantum computing concepts can be leveraged for quantum-inspired computing using conventional logic circuitry.
- Explain why quantum computing is considered an important technology for the future and give examples of how it is most likely to be applied.

Regular and Substantive Interaction / Academic Engagement

Regular and substantive interaction (RSI) mechanisms will be used to ensure academic engagement between students and course staff if circumstances dictate that portions of this nominally in-person course must be taught using online mechanisms.

Course Details

Tentative Course Schedule

The internal schedule of this course is a bit of a guess and is subject to change, as this course is entirely new and being taught for the first time…

```
1/13      Introduction, parallel and quantum
1/15      ""
1/20      ""
1/22      Classical & adiabatic logic
1/27      ""
1/29      ""
2/ 3      "" and first team project
2/ 5      Quantum concepts and models
2/10      ""
2/12      ""
2/17      Quantum circuits and algorithms
2/19      ""
2/24      "" and second team project
2/26      Quantum annealing
3/ 3      Midterm exam
3/ 5      NISQ computer implementations
3/10      ""
3/12      "" and first individual homework assignment
3/17      No class; Spring break (midterm grades available)
3/19      No class; Spring break
3/24      Quantum-inspired methods
3/26      ""
3/31      ""
4/ 2      "" and third team project
4/ 7      Architecture of computer with quantum coprocessor
4/ 9      ""
4/14      Higher-level quantum programming
4/16      "" and second individual homework assignment
4/21      Where is quantum going?
4/23      this day reserved for schedule slippage
4/28      Review for final exam (last class; no assignments)
4/30      No class; Reading Day
5/ 5      Final exam in person from 10:30AM–12:30PM
```

The two dates shown in orange, **3/3** and **3/5**, it is expected that Professor Dietz will be presenting research work at the IS&T Electronic Imaging (EI26) conference. Thus, these lectures might be conducted via Zoom rather than in person or the schedule might be shifted-back to allow that content to be presented in person and up to two other lectures presented as recordings. Unfortunately, the midterm might fall on one of these days; it will either be proctored by someone else or the schedule will be re-arranged. Any such variations in the schedule will be discussed in class and formally announced via Canvas.

We are still tweaking the presentation and minor adjustments to the schedule are likely depending on how this group of students handles specific portions of the material. Such adjustments are most likely to involve slightly extending or contracting the time for individual topics. More significant changes may be required if the University of Kentucky has a closure due to weather or other circumstances beyond our control interfere with the normal operation of the course. Students would be notified of any significant changes to schedule or content via Canvas and/or the course web site: https://aggregate.org/QC/

Course Activities, Assignments, Exams
This semester, course activities are focused on projects and homework, with two exams: a midterm and a final, both expected to be done in person.

The **three team projects** will involve some programming using simulation environments, most likely Verilog, Qiskit, and C++. All projects will be submitted via Canvas. The **two homework assignments** planned are to be completed individually. The ***students taking the course for graduate credit, either under the 699 number or as a 599 for AMP credit, will have somewhat more to do on some projects/assignments***.

There will be both a **midterm** and a **final exam**. The current plan is that each will be administered in person. Any requests to take the exams at different times will be given serious consideration provided they are submitted via email before the scheduled timeslot. The final exam timeslot designated by the registrar is **10:30AM-12:30PM Tuesday, May 5, 2026**. The final exam will be comprehensive and may include any material covered as described in the review session – even topics that were not a component of any project or homework.

The expected weighting for computing your course grade is:

10%　First team project
10%　Second team project
20%　Midterm exam
10%　First homework
10%　Third team project
10%　Second homework
30%　Final exam

We reserve the right to tweak the above weightings, or to apply modest adjustment to grades, if there are problems with a particular component for the class in general. For example, if a flawed project specification made some part more difficult to accomplish than we had intended, we might give all teams full credit for that part.

Although there is no grade for class attendance or participation per se, it is expected that all students will regularly attend class in person unless there is a good reason not to (illness, travel to represent a UK team or research, etc.). We intend to record class lectures, but might or might not make the recordings available to all students in the class; recordings are not intended to serve as a substitute for regular attendance of class unless you have a valid reasons for being unable to attend. Participation in team projects is more directly involved in your grade via peer evaluations that may be used to apply an offset to an overall grade for the team. Failure to appropriately contribute to a team project may result in a corresponding reduction in an individual's grade for that team project. In general, we will not apply that reduction to an individual's project score unless their lack of contribution is extreme or repeated across two or more projects.

Grading Scale
Nominally, the grading scale is:

```
90 ≤ 100%    : A
80 <  90%    : B
70 <  80%    : C
60 <  70%    : D
   <  60%    : E
```

Adjustments may be made to scores of specific graded materials as described in the previous section. Typically, any such adjustments are in the student's favor except for penalties imposed for failure to contribute to team projects.

Midterm Grades

For undergraduates, midterm grades will be posted in myUK by the deadline published in the [Academic Calendar](https://registrar.uky.edu/academic-calendars/university). (https://registrar.uky.edu/academic-calendars/university). Note that midterm grades will be based on the work completed and graded up to that point, which does not have the same ratio between projects, homework, and final exam as the course overall. In order to make your midterm grade more predictive of your overall final grade for the course, the midterm grade may be computed by a weighting formula somewhat different from those given in the previous section.

Attendance Policy/Acceptable Documentation

Although this course does not give grades for attendance nor class participation, students are expected to regularly attend class, and there may be class time allocated for students to coordinate their work on project teams, which would be missed by those not attending in person. The University of Kentucky generally expects appropriate documentation for an excused absence: e.g. a letter from a healthcare provider. In this course, we will generally be more flexible and *notification beforehand via email* to hankd@engr.uky.edu, with "QC" in the subject line, will be accepted as a valid reason for an excused absence. Students missing class meetings generally are responsible for catching up on the material missed even if the absence is excused, although excused absences may be taken into account, for example, by extending assignment or project deadlines. Class presentation recordings generally will be made available to help those with an excused absence, but not necessarily to students with unexplained absences.

As described earlier, lack of appropriate participation in a project team can directly reduce your grade from the grade assigned for the team overall.

General university guidelines relating to attendance are summarized at: https://provost.uky.edu/proposals/guidance-course-proposals/standard-academic-policy-statements

Assignment Policies

Assignment Submissions

All assignments will be collected electronically using software to be discussed in class and via Canvas. Projects require submitting more than one file, in which case students are expected to submit either a `tar` or `zip` archive containing the files.

Returning Assignments to Students

Graded homework and projects generally will be available via Canvas, but not necessarily immediately after grading. Posting may be delayed somewhat to allow students with excused absences time to submit. All grades will be posted before the class period in which we will review everything for the final exam. Generally, the course TA is the primary contact for questions about graded materials. The graded final exams are kept on file and can be accessed by meeting with the course instructor.

Late Assignments

Online assignments are expected to be submitted no later than the specified deadline, but the submission mechanisms generally will accept late submissions. Except in cases of excused absences, it is entirely at the discretion of the instructor as to how much, if any, credit will be awarded for a late submission. Late assignments that are submitted after the assignment answers are posted or discussed in class generally are given zero credit, but ones submitted before any answers have been made available are more likely to be given some credit. It is also useful to note that most assignments can be submitted multiple times without penalty, in which case only the last one submitted before the deadline is considered for grading.

Assignments Due during Prep Week

No assignments will be due during Prep or Reading Days. However, it is possible that make-ups for excused absences, review sessions, or optional activities (such as a lab tour) would be scheduled during that time.

University Policies and Student Support

The following links access university policy and student support:

- Academic policy statements are at https://provost.uky.edu/proposals/guidance-course-proposals/standard-academic-policy-statements
- Mental health resources are at https://studentsuccess.uky.edu/get-help
- Academic support is at https://studentsuccess.uky.edu/academicresources
- Disability resource center (DRC) information is at https://studentsuccess.uky.edu/disability-resource-center
- Academic ombud contact is https://ombud.uky.edu/students
- Classroom Emergency Preparedness and Response information is at https://provost.uky.edu/instructor-resources

A full list of UK academic policies is available at:
https://provost.uky.edu/proposals/guidance-course-proposals/standard-academic-policy-statements .

Academic Offenses (Cheating, Plagiarism, and Falsification or Misuse of Academic Records)
Whatever is stated in the following document applies:
https://provost.uky.edu/proposals/guidance-course-proposals/academic-offenses

In the classroom, students should not take any actions that would disrupt the classroom environment (e.g., talking on a cell phone during class). In general, students are expected to behave in a respectful way towards their fellow students, the TA, and the instructor. Failure to follow University of Kentucky guidelines involving appropriate precautions against the spread of COVID-19 or other communicable diseases will be treated as a very serious offense and dealt with as specified by the University.

Students are expected to generally behave ethically, and violations will be treated as serious offenses. Altering graded exams and then submitting them for regrade is obviously unethical, but you do not need to be trying to enhance your grade in order for your behavior to be inappropriate. For example, attempts to break into computer accounts associated with this course or to falsely identify yourself are serious ethical violations even if there was no intent to "cheat" per se.

There are lots of study materials for this course, including old exams, widely available; using them as study aids is perfectly acceptable, but be warned that an apparent reuse of an old question usually has the question slightly reworded so that the old answer is not correct. Although students are encouraged to discuss course material with one another, everything you submit must be entirely your own original work. Similarly, for in-class exams that specify no textbooks, no calculators, etc., use of the banned resources is a serious offense. For assignments submitted online, the general rule is that referencing your notes, looking at online materials on the course website, etc. is OK. Submitting the work of another person, or of an AI tool, as your own original work is not OK.

Resources
There is a wide range of resources available to help you with this course, the most relevant of which will be cited on either Canvas or the course website. Arguably the most important resources are the instructor, TA, and your classmates – and you are strongly encouraged to interact.

The University of Kentucky and the Pigman College of Engineering offer a wide range of student support services. Below are links to a few good starting points for finding the support you may need for success in your studies:

- Center for Support and Intervention: https://studentsuccess.uky.edu/center-support-and-intervention/resources/student-resources

- UK Student Success services page: https://studentsuccess.uky.edu/find-services

- James and Gay Hardymon Center for Student Success https://www.engr.uky.edu/students/student-success

- Disability Resource Center: https://studentsuccess.uky.edu/disability-resource-center

- Tutoring and Coaching: https://studentsuccess.uky.edu/academicresources and https://engr.uky.edu/student-success/engineering-tutoring

Course Recordings

The University of Kentucky Code of Student Conduct (https://studentsuccess.uky.edu/student-conduct) defines Invasion of Privacy as using electronic or other devices to make a photographic, audio or video record of any person without their prior knowledge or consent when such a recording is likely to cause injury or distress.

Meetings of this course may be recorded. All video and audio recordings of lecturers and class meetings, provided by the instructors, are for educational use by students in this class only. They are available only through the Canvas shell for this course and are not to be copied, shared or redistributed.

As addressed in the Code of Student Conduct, students are expected to follow appropriate university policies and maintain the security of linkblue accounts used to access recorded class materials. Recordings may not be reproduced, shared with those not enrolled in the class or uploaded to other online environments.

If the instructor or a UK office plans any other uses for the recordings, beyond this class, students identifiable in the recordings will be notified to request consent prior to such use. In anticipation of such cases, students may be asked to complete an "authorization of use" form by a faculty member.

Video and audio recordings by students are not permitted during the class unless the student has received prior permission from the instructor. Any sharing, distribution and or uploading of these recordings outside of the parameters of the

class is prohibited. Students with specific recording accommodations approved by the Disability Resource Center should present their official documentation to the instructor.

Course Copyright

All original instructor-provided content for this course, which may include handouts, assignments, and lectures, is the intellectual property of the instructor. Students enrolled in the course this academic term may use the original instructor-provided content for their learning and completion of course requirements this term, but such content must not be reproduced or sold. Students enrolled in the course this academic term are hereby granted permission to use original instructor-provided content for reasonable educational and professional purposes extending beyond this course and term, such as studying for a comprehensive or qualifying examination in a degree program, preparing for a professional or certification examination, or to assist in fulfilling responsibilities at a job or internship; other uses of original instructor-provided content require written permission from the instructor in advance.

Policy on Artificial Intelligence

AI tools, such as ChatGPT, may be used in limited ways, but ***an AI-generated response used directly is not considered to be your own work***. It is also noteworthy that although LLMs regularly produce coherent-looking answers to homework questions and even can give justifications for their answers, for CPE380 we have found that the answers given by ChatGPT are factually wrong about 40% of the time. This leads to the disturbing observation that students assisted by ChatGPT tend to answer more questions incorrectly than they would on their own!

Don't let an AI convince you to give a wrong answer. Similarly, many WWW searches find unvetted and incorrect answers to questions posed in this course. Thus, for any AI and search tools you employ to help you create your original work answers, be sure to follow the old rule of "trust, but verify" for factual content. The course materials themselves are by far the most trustworthy sources for answers to questions.

This syllabus was last updated January 19, 2026 by H. Dietz.

Appendix: Classroom Emergency Preparedness and Response

Nothing is more important than the safety and well-being of our campus community. While the University of Kentucky Police Department continues to enhance campus safety measures, it's important to remember that everyone has a responsibility in keeping our community safe. To find more information visit Emergency Response Guide | University of Kentucky Police Department (uky.edu)

Emergency Reporting & Action

Reporting

If there is an emergency, **DIAL 911.** To report suspicious activity or non-emergency situations, call the UK Police Department at 859-257-8573 or #UKPD from any mobile phone.

If an emergency occurs in a classroom or residence hall with a red emergency button, press to quickly notify UKPD. Emergency responders will immediately be dispatched to your location.

Action

During an emergency, you are responsible for your own safety.

If an emergency occurs during class, your instructor will provide further direction based on university and department emergency plans.

Warning Systems

UK Alert

The university provides emergency notifications through UK Alert, which sends messages via email, text message, phone calls, building alarm systems, digital signage, social media and outdoor sirens. If you receive a UK Alert message during class, notify your instructor and classmates immediately.

For more information, visit https://police.uky.edu/get-notified/uk-alert .

LiveSafe

The university provides additional emergency preparedness information and safety tools through LiveSafe, a free mobile app for iOS and Android. You can report suspicious activity, message with UK Police and virtually escort your friends through the SafeWalk tool.

For more information, visit https://police.uky.edu/safety/livesafe

Blue Emergency Towers

Blue Emergency Notification Towers are strategically placed at over 50 locations across campus to provide outdoor alert tones and broadcast emergency messages with loud speakers. Each tower also features an emergency push button speaker phone that reaches UKPD and a camera mounted above the tower.

For more information, visit https://police.uky.edu/safety/blue-emergency-towers

Medical Emergency

If there is a medical emergency, dial 911 and do not act outside the scope of your medical training. After dialing 911, inform your instructor of the situation.

Appendix: Classroom Emergency Preparedness and Response

Evacuation

It is required to evacuate for a fire alarm or when university officials order us to do so. Evacuation routes are marked with illuminated exit signs throughout the building. Avoid using elevators during any evacuation.

Emergency Sheltering

Storm Sheltering

Report to the recommended shelter locations. Recommended shelter locations are marked throughout the building.

If shelter locations are unavailable, protect yourself from lightning and flying debris by moving to an interior room or hallway on the building's lowest level. Avoid outside doors and windows and get under a sturdy table and use your arms to protect your head and neck.

Shelter-in-Place

If a shelter-in-place order is issued, you will learn about this through UK Alert, the university's emergency notification system.
If you are inside, stay where you are unless the building you are in is affected. If the building is affected, and the fire alarm has been activated or directed by law enforcement, you should evacuate. If you are outdoors, proceed into the closest UK building or follow instructions from emergency personnel or alerts.

It is ideal to shelter-in-place in an interior room with the fewest or no windows and no doors to the outside if possible. Shut all windows and close exterior doors.

If a hazardous chemical release occurs outside the building, follow these same procedures.

Active Aggressor

In a situation where an aggressor is trying to attack you or others, follow three steps:

1. **Run** - Attempt to get away from the attacker.
2. **Hide** - If you cannot run, barricade yourself in a safe place. Turn your phone to silent and dim your
brightness. If possible, use the LiveSafe App to message UK Police and alert them to your location. If you don't have the app, dial 911. If you cannot speak, leave the line open and allow the dispatcher to listen.
3. **Fight** - If you cannot run or hide, do whatever you need to do to stop the attacker.

UK Police will communicate additional information through the UK Alert system during an active aggressor situation. Every UKY email automatically receives UK Alerts. You can also sign up in myUK to receive alerts via text and phone call.