



Fall 2025: ELEC 5970/6970

Quantum Information and Computation

Time: Tue./Thu. 11:00 am - 12:15 pm

Where: Lectures - Broun Hall 306; Labs - **Shelby 3205**

Instructor: Dr. [Zihe Gao](mailto:zzg0036@auburn.edu) (zzg0036@auburn.edu)

Last updated: August 20, 2025

Prerequisite: Prerequisite: ELEC 2120. (Students from other departments require faculty approval.)

Course Description: This course introduces the principles of quantum information science, quantum computing, communication, and sensing, beginning with the fundamentals of quantum mechanics for students without a physics background. Topics include superposition, entanglement, measurement, quantum algorithms, quantum key distribution (QKD), and quantum sensing.

Course Outline

- **Part 1: Foundations of Quantum Mechanics** – Wave-particle duality, superposition, uncertainty, Dirac notation, qubits (spins and photon polarization).
- **Part 2: Quantum Computing** – Quantum gates, circuits, teleportation, Shor's & Grover's algorithms, and error correction.
- **Part 3: Quantum Communication & Sensing** – QKD (BB84, E91), quantum optics, and quantum metrology.

Tools & Software

- Python (optional tutorial may be provided).
- Qiskit (IBM's quantum SDK – free and open source).

Grading

- Homework (Math + Coding): 50%
- Quizzes & Concept Checks: 10%
- Midterm Exam: 20%
- Final Project: 20%

Textbook:

- Paul Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press (2007)
- Nielsen, M.A. and Chuang, I.L. (2010). Quantum Computation and Quantum Information (10th anniversary ed.). Cambridge University Press.

Course Policies

Course Communications: Course materials and announcements will be posted on Canvas. Students are advised to visit Canvas regularly.

Homework Submission: Homework assignments must be submitted electronically through Canvas. You can scan your handwritten solutions and upload them, or directly write on your pad, or use LaTeX for typesetting. We will reward the use of LaTeX with a 5% bonus on your homework points. A LaTeX template will be provided for writing solutions.

Late Homework Submission: Late homework assignments are NOT accepted. If you have to turn in LATE, please inform the instructor for approval well ahead of the deadline.

Course Project: To be announced so that the scopes are appropriate based on the number of enrollments and the background / research interests.

Academic Dishonesty: All cases of academic dishonesty will be handled promptly following the University's Student Academic Honesty Code. (<https://www.auburn.edu/academic/provost/academic-honesty/>).

Student's with Special Needs: In accordance with the Americans with Disabilities Act, students with bona fide disabilities will be afforded reasonable accommodation. The Office of Accessibility will certify a disability and advise faculty members of reasonable accommodations. If you have a specific disability that qualifies you for academic accommodations, please notify the instructor/professor and provide certification from the Office of Accessibility as early as possible. (The Office of Accessibility is located at 1228 Haley Center, phone: 334-844-2096).

Changes in Course Requirements: Since all classes do not progress at the same rate, I may wish to modify the above requirements or their timing as circumstances dictate. For example, I may wish to change the number and frequency of exams, or the number and sequence of assignments. However, students will be given adequate notification of any changes. Moreover, there may be non-typical classes for which these requirements are not strictly applicable in each instance and may need modification. If such modification is needed, it will be in writing and conform to the spirit of this policy statement.