Phys 8803, Syllabus

- **Course Prefix and Number:** PHYS 8803, Quantum Information, 3 credits
- **Term:** Summer 2026

Instructor Information

Instructor: Brian Kennedy
Email: brian.kennedy@physics.gatech.edu

General Course Information

Description

The foundations of quantum information theory including an introduction to quantum computing, quantum error correction, open quantum systems, von Neumann entropy, strong subadditivity of entropy and modern research topics.

Course Learning Outcome

To develop an understanding and problem solving skills in the following:

- quantum computing circuits and algorithms
- quantum error correction
- open quantum systems, completely positive maps and markovian master equations
- paradigms of quantum information: quantum teleportation, super-dense coding, quantum cryptography
- modern topics: e.g. quantum Shannon theory, random Haar measure, t-designs, quantum complexity

Required Course Materials

Quantum Computing and Quantum Information tenth anniversary edition (Cambridge 2010) by Michael A. Nielsen and Isaac L. Cuang is the required text.

Grading Policy

Letter grade: A ≥ 90, 89 ≥ B ≥ 80, 79 ≥ C ≥ 70, 69 ≥ D ≥ 60 > F

Assignments

- Midterm: 30 %
- Homework: 20 %
- Project: 50 %

Description of Graded Components

The midterm will be take-home. The project will involve some limited theoretical research, not a survey article. Potential topics may be identified in journals such as *Quantum*, *Physical Review*, *Communications in Mathematical Physics*, *Nature*, *Science* and by consultation with the instructor.

Course Policies

Attendance Policy

Classroom participation is expected. Moreover, students with poor attendance have significantly weaker exam performance than those students who attend regularly. Therefore, attendance may be counted in determining your final grade.

Academic Integrity and Research Honesty Statement

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review the Student Code of Conduct and the Academic Honor Code Students are expected to perform research in an ethical and responsible manner. All Doctoral and Master's Thesis students are required to take the Responsible Conduct of Research training, and it is expected that students abide by the principles taught in that training while performing research.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Core IMPACTS

Not applicable

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulates some basic expectations that you can have of me and that I have of you. Additional information for research-related work is given in The Expectations of Advisors and Advisees. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Pre-and/or Co-Requisites

- Phys 6105 (Quantum Mechanics I) or equivalent

or the permission of the instructor (especially for non-physics majors with a strong interest/theoretical background). A strong mathematical background in linear algebra and a familiarity with undergraduate quantum mechanics is essential.

Collaboration, Group Work and Use of Generative AI

Students are permitted to work in groups on all homework assignments, but work you turn in must be written/typed in your own hand (not AI generated). Use of old homework solutions and generative AI to produce solution sets is discouraged.

Extensions, Late Assignments and Re-Scheduled/Missed Exams

Late homework may be subject to penalties. Make-up exam requests require documentation, and are given for illness, approved institute activities and religious observances. Additional accommodations can be made for students whose presence elsewhere is required by law, or for whom a request is made by the Office of the Dean of Students.