

## Quantum information (PHYS 521)

Syllabus: AY21/22

Instructor: Mark Rudner

This course will cover the fundamentals of quantum information. The goals of the course are to provide familiarity and an introduction to the essentials of quantum information, and to prepare you to be able to begin reading the literature in the field (potentially towards beginning research) and/or to take more advanced courses in related areas. We will mostly follow the book *Quantum Computation and Quantum Information* by Nielsen and Chuang, with supplementary materials distributed for specific topics along the way. The prerequisite for this course is at least one quarter of graduate level quantum mechanics (PHYS 517/518 or equivalent).

1. General introduction: Formal structure of Hilbert space, quantum states, observables and dynamics.
2. Entanglement and density operators. Bell inequalities.
3. Classical circuits, computational universality and complexity classes.
4. Quantum circuits and universal models of quantum computation.
5. Quantum Fourier transform and related algorithms.
6. More algorithms: quantum cryptography, Grover's search algorithm.
7. Open quantum systems: noise and quantum channels.
8. Quantum error correction.
9. Physical implementations: quantum information processing devices.

If you have any questions about the course, please feel free to contact the instructor at [rudner@uw.edu](mailto:rudner@uw.edu).