Course Description

The topic of this seminar will be quantum information and computation. The seminar does not require any background in quantum physics or in quantum computation. As this is a theory seminar we will focus on the theoretical aspects of the field rather than study physical implementation of quantum information systems.
The first couple of lectures will be given by myself and will cover the necessary background - the relevant rules of quantum mechanics and the mathematical formulation of quantum states and quantum circuits. The necessary math background is mainly elementary probability theory and vectors and matrices over complex numbers.

Each student (or pair of students, depending on enrollment) will then prepare and present a lecture of up to 3 academic hours on the following topics (tentative):

1. Superdense Coding and Quantum Teleportation
2. Quantum cryptography (BB84 protocol + one more)
3. Deutsch's algorithm, Deutsch-Jozsa algorithm
4. Simon's algorithm
5. Grover's algorithm
6. Quantum FFT and Shor's algorithm (probably 2 lectures)
7. Quantum error correcting codes, fault tolerant QC and the threshold theorem
8. Quantum complexity classes and quantum supremacy

The student delivering the class will compose and grade a short problem set to be solved by the other students.

Course Goals

1. Obtain a general understanding of the field of quantum information and computation.
2. Obtain the ability to describe and analyze quantum information and computation processes in a precise mathematical way.
3. Improve and practice presentation skills and the ability to effectively describe complex ideas in a precise and understandable manner.

Grading

Lecture 75%

homework assignments 20%

homework grading 5%

Participation (possibly online participation) in all classes is mandatory. There will be a penalty for missing classes. The penalty will grow exponentially with the number of missed classes.
Reading List

We will use lecture notes from courses in other universities and other online material. A list will be available on the course's website.

A related textbook is Quantum Computation and Quantum Information by Chaung and Nielsen