
Objectives:

At the conclusion of this course, students will be expected to
1. know basics of complex numbers and how to manipulate them;
2. understand some fundamental ideas in vector spaces;
3. know how to manipulate quantum gates;
4. be able to understand and write basic quantum algorithms.
5. They should also have a general outline of the more advanced and speculative parts of the field.

Syllabus:

Week 1: Overview of Quantum Computing
   History (Feynman, Deutch, Grover, Shor)
   Double-slit experiment
   Superposition
   Contemporary experimental results

Week 2 and 3: Basic mathematical preliminaries.

Week 4: Basic quantum theory
   State Spaces,
   Bras and Kets
   Evolution
   Measurements

Week 5: More quantum theory
   Superposition
   Entanglement

Week 6: Gates and Quantum Gates
   Review of Classical Gates
Qubits
Universal quantum gates

Week 7-9: Quantum Algorithms
  Deutsch’s Algorithm
  Deutsch-Jozsa Algorithm
  Simon’s Periodicity Algorithm
  Grover’s Search Algorithm

Week 10: Factoring Algorithms
  Some mathematical background
  Shor’s Algorithms
  Cutting edge implementations

Week 11: Quantum Complexity Theory
  Basic complexity classes
  Quantum Turing Machines
  BPP, BQP

Week 12: Quantum Cryptography
  BB84; B92

Week 13: Implementations and Realizations
  Optical photon; Nuclear magnetic resonance; Ion traps

Bibliography:
Course Text:

Other Texts:

Supplementary Texts: