UNIVERSITY OF SOUTHERN CALIFORNIA
DEPARTMENT OF ELECTRICAL ENGINEERING

EE 520 Introduction to Quantum Information Processing

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Text: *Quantum Computation and Quantum Information*
Michael A. Nielsen and Isaac L. Chuang (Cambridge, 2000);
Lecture Notes

Required Preparation: A strong knowledge of complex linear algebra and probability theory, such as that obtained from EE 441 and EE 464

Week	Subjects	Text pages & Homeworks
1	General overview. The Stern-Gerlach experiment and spin-1/2 particles. Quantum bits.	1-17, 42-50
2	Review of linear algebra; Dirac notation; projectors; decompositions of the identity; tensor products. Postulates of quantum mechanics. Quantum registers.	60-90
3	Unitary transformations and time evolution. Schrödinger equation. No-cloning theorem. Entangling interactions.	17-28 HW #1 due
4	Examples of implementations using optical systems. Quantum gates. Quantum circuits. Entanglement. Quantum teleportation. Measurement and interference. Born rule. Complementarity and uncertainty.	171-185, 50-58, 90-98,
5	BB84 quantum cryptography. Quantum operations. Shannon entropy.Classical bits, circuits and Boolean functions. Reversible and irreversible gates.	185-188, 120-169 HW #2 due
6	Computational complexity classes. Quantum oracles and Deutsch's algorithm.	28-42
7	Universal sets of quantum gates. Circuits and general unitary transformations. Quantum Fourier transform and period finding.	188-204, 216-221 HW #3 due

Week	Subjects	Text pages & Homeworks
8	Phase estimation and Shor's factoring algorithm. Computational complexity of Shor's algorithm. Comparison to best classical algorithm.	221-247
9	Grover's search algorithm. **Midterm Exam.**	248-255
10	Mixed states and density matrices. Completely positive maps. Partial trace. Von Neumann entropy. Decoherence and effect of environment. Schmidt basis. Effective evolutions. Master equations.	98-118, 353-373, Choose projects, HW #4 due
11	Quantum trajectories. Random error model. Simple error correction. Quantum error correcting codes. Stabilizer codes.	373-398 425-474
12	Operations on encoded q-bits. Concatenated codes. Fault-tolerant quantum computation. Threshold theorem. Brief overview of other topics in quantum information.	474-497 HW #5 due,
13	Implementations. The DiVincenzo criteria. Linear ion trap. NMR. Achievements to date. Prospects of other techniques. Other potential applications.	277-349 Projects due
14-15	Presentation of student projects.	
	Thanksgiving Holiday Thu-Sun 27-30 Nov 2008	

Final exam: Tue 16 Dec 2008, 11 am -- 1 pm

Office hours: TBA

Course Grade:

Problem Sets	15%
Student Project	15% (7.5% written report, 7.5% oral presentation)
Midterm	25%
Final Exam	45%