Revised August 31, 2001

EECS 598-1: (Special Topics in EECS, Course No. 1897)

New Course for Fall 2001

QUANTUM COMPUTING CIRCUITS

Summary: This special-topics course is intended to explore the exciting new area of quantum computation, focusing on the design and analysis of quantum logic circuits. No prior knowledge of quantum computing or quantum physics is required, but participants will be expected to read and present papers on topics of interest. After a set of introductory lectures on basic principles, the course will cover the following topics: quantum circuit synthesis, simulation and testing, matrix methods, algorithm implementation, error-correction techniques, experimental systems, research problems.

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Prerequisites: Graduate standing or permission of instructors. Participants should have a strong background in logic synthesis, linear algebra, and algorithms.

Credits: 1 to 3 units depending on the amount of work done. This course has been approved for 500-level credit in CSE.

Lecture Schedule: Thursdays 3:00 - 5:00pm, EECS Room 3427

Coursework: A set of approximately six homeworks and a term project will be required. In addition, each enrolled student will be expected to present one recent research paper.

Required Textbook: *Quantum Computation and Quantum Information* by Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 2000.

LECTURE SCHEDULE (Tentative)

1. (Sept. 6) Course organization. Introduction to quantum computing (I. Markov)
2. (Sept. 13) Mathematics basics. Matrix and tensor algebra (I. Markov)
3. (Sept. 20) Physics basics. Quantum mechanics and computation (D. Steel)
4. (Sept. 27) Logic circuit basics. Quantum gates and circuits (J. Hayes).
5. (Oct. 4) Algorithm and data structure basics. Introduction to quantum algorithms (I. Markov).
6. (Oct. 11) Quantum algorithms (cont'd). Shor's and Grover's algorithms (D. Motter).
7. (Oct. 18) Quantum circuits (cont'd). Synthesis approaches of Cybenko et al. (V. Shende and A. Prasad).
8. (Oct. 25) Term project discussion and assignments (J. Hayes and I. Markov).
9. (Nov. 1) Quantum circuit implementation. Experimental quantum computing devices (C. Monroe).
10. (Nov. 8) Student presentations.
11. (Nov. 15) Student presentations.
12. (Nov. 29) Student presentations.
13. (Dec. 6) Student presentations. Course wrap-up discussion.