AM 584b, Winter 2005

QUANTUM COMPUTATION AND INFORMATION-I

Time & Place: Friday, 2:00-5:00 pm, MC 15B

Instructor: Dr. Alex Buchel , office MC 264 , Ext: 88794 , E-mail: **abuchel@uwo.ca**

Office hours: by appointment

Course webpage: **http://abuchel.apmaths.uwo.ca/∼public/qic2005/**

Prerequisites:

For undergraduate students: AM213b (Linear Algebra II) with a minimum mark of 75% is required.

A previous course work in Quantum Mechanics, Statistical Physics, (classical) Computer Science (information theory, algorithms theory, complexity theory) is very useful, but not essential.

Course outline:

I. Introduction:

a. Physics of information

b. Quantum bits and elementary quantum computation

c. Quantum teleportation, Deutsch-Jozsa algorithm

d. Quantum hardware

e. Quantum information

II. Introduction to Quantum Mechanics:

a. Linear algebra

b. Axiomatic quantum mechanics

c. Quantum measurement

d. Quantum entanglement, and its applications: superdense coding

e. The density operator

f. EPR and the Bell inequality

III. Introduction to computer science:

a. Universal Turing Machine

b. Computational resources

c. Computational complexity theory

IV. Quantum computation:

a. Elements of quantum circuits

b. Universal quantum gates

c. Quantum computational complexity

V. Quantum Fourier transform and its applications:

a. The quantum Fourier transform

b. Applications: order-finding

c. Applications: factoring

VI. Quantum search algorithm:

a. Quantum search algorithm

b. Performance

c. Optimality of the search algorithm

Text:

The primary text is a book by Michael Nielsen and Isaac Chuang "Quantum Computation and Quantum Information".
Additional resources will be posted on the course webpage.

Course evaluation:

Course grade will be based on a number of homework assignments (to be specified). There will be no final exam.

Feedback to the instructor regarding the quality, speed, and content of presentation is especially appreciated during the semester!