Quantum Information and Computing
Math 4252/Phys 4852

Instructor
Dr. Stephanie Curnoe
Office: Room C3013, Phone 864-8888

Schedule
12:30-1:45 Tuesdays and Thursdays Room C3067
Another 50 minutes/week, time and place to be decided
The course will have two 75 minute and one 50 minute lecture slots per week. In a typical week, the longer classes will be traditional lectures (and may be shortened to 50 minutes) while the third class will be devoted to discussion and problem-solving.

Textbook
Quantum Computing From Linear Algebra to Physical Realizations by Mikio Nakahara and Tetsuo Ohmi

Recommended reference
Quantum Computation and Quantum Information by Michael A. Nielsen and Isaac L. Chuang

Outline
The objectives of this course are to provide students with an introduction to the theory of quantum computing and to enable students to access a real quantum computer. The topics that will be covered in this course are

1. Linear Algebra: Hilbert space, Hermitian operators, eigenvalue problems (Chapter 1 of textbook)
2. Postulates of Quantum Mechanics (Chapter 2)
3. Qubits and Quantum Key Distribution (Chapter 3)
4. Quantum gates and quantum circuits (Chapter 4)
5. Quantum algorithms (Chapter 5)
6. Quantum Integral Transforms (Chapter 6)

7. Search Algorithm (Chapter 7)
8. Shor's Algorithm (Chapter 8)
9. Physical realizations of quantum computers (class projects; Chapters 11-16)
10. Programming and accessing real quantum computers (Xanadu Quantum Codebook)

Evaluation Scheme
Xanadu Quantum Codebook solutions: 10%
Other assignments: 10%
Test 1 (February 15): 20%
Test 2 (March 21): 20%
Final examination: 40%

Xanadu Quantum Codebook solutions: PennyLane is a python-based software package for programming quantum computers created by Xanadu, a Canadian quantum computing company. Xanadu's online textbook, Xanadu Quantum Codebook, contains many exercises in the form of programming challenges using PennyLane. Students will complete modules I.1 to I.15 during the course, with a few problems assigned each week. The solutions to these problems will be discussed during the class, as described above. Students will submit their solutions (can be hard-copy or electronic) to all of the problems in the first module (modules I.1 to I.15).

Tests: The tests will be usual, closed-book exams, held during the regular lecture time.

Final exam: The final exam will be held within the final exam period.

Important Dates
Thursday, February 15: test 1
Monday, February 19 to Friday, February 23: no classes (midterm break)
Thursday, February 29: last day to drop the course
Thursday, March 21: test 2
Friday, April 5: last class

Wednesday, April 10 to Friday, April 19: final exams

Prerequisites
Mathematics 2051 or PHYS 3820

Missed Tests
If you miss a midterm test because of illness or other acceptable cause you must send an email to the course instructor, Dr. Stephanie Curnoe, curnoe@mun.ca, within two days of missing the test. Please see the Calendar, Section 6.7.5, **Exemptions from Parts of the Evaluation**. A doctor's note is not required unless your illness or medical condition persists for at least five days. Documentation for other reasons (such as bereavement) is required. If you miss a midterm test because of illness or other acceptable cause then another test will be scheduled during class time.

Missed Final Exam
Please consult the University Calendar, **6.8.2 Exemptions From Final Examinations and Procedures for Applying to Write Deferred Final Examinations**.

Academic Misconduct
Memorial University adheres to the highest standards of academic integrity. Please consult the University Calendar, **6.12 Academic Misconduct**.

Use of Recording Devices in Classrooms
The lectures and displays (and all material) delivered or provided in this course, including any visual or audio recording thereof, are subject to copyright owned by Dr. Curnoe. It is prohibited to record or copy by any means, in any format, openly or surreptitiously, in whole or in part, in the absence of express written permission from Dr. Curnoe any of the lectures or materials provided or published in any form during or from the course. Students must not record, publish, send, post on an internet site, sell, rent, or otherwise distribute this work without Dr. Curnoe's express written permission.

Memorial University is committed to accommodating students with disabilities.

A final note about disruptions due to natural disasters (pandemics, snowstorms, etc)

If a midterm test is disrupted because of a university closure then students should anticipate that the test will be held in the first 75 minute class following reopening of the university.