uOttawa

MAT 4996 (also offered as MAT 5991)

Introduction to Quantum Information

starting September 5th 2014
Tuesdays 08:30–10:00 & Fridays 10:00–11:30
585 King Edward (KED); Room B005

Instructor: Dr. Anne Broadbent
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Office Location: KED 204-C; phone x2104
Office Hours: Tuesdays 10:00–10:30 & Fridays 11:30–12:00 or by appointment

Teaching Assistant: Kevin Piché
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Office Hours: Wednesdays 14:00–15:00 in KED B015 (starting Sep. 17) .

Syllabus. Dated August 28, 2014.

Learning Objectives
By the end of this course, students will be able to:

- recognize the differences between classical and quantum information in the context of computation;
- predict the outcomes of quantum operations on closed quantum systems;
- understand and construct quantum circuits;
- explain and apply paradigms of quantum information theory such as the no-cloning theorem, teleportation, entanglement, quantum algorithms and quantum error correction;
- understand and explain the advantages and limitations of quantum information in the context of cryptography;
- identify a number of advanced topics in quantum information processing as presented by classroom peers;
- **(MAT5991 only)** select, summarize and defend an advanced topic in quantum information processing; relate and compare this topic with material in the course;

Official Course Description: Introduction to the quantum information framework; teleportation; nonlocality; quantum key distribution; ~~quantum information theory~~; quantum algorithms; quantum error correction and fault-tolerant quantum computation.

Target Audience: This course is open to all those who are curious about information processing in a quantum world. Students may have a background in Mathematics, Physics or Computer Science (this list is not exhaustive). No prior knowledge of quantum physics will be assumed, although a certain mathematical maturity (see below) is required.

Prerequisite(s): MAT2141 or MAT3341 or a solid background in linear algebra.

Textbook: I recommend that you come prepared to class, having read the assigned readings that will be from the following textbook:

- Michael A. Nielsen, Isaac L. Chuang. *Quantum Computation and Quantum Information.* Available online via the uOttawa library `http://orbis.uottawa.ca/record=b4377427~S0*eng`.

Note, however, that the scope of the above textbook is much broader than the scope of MAT 4996; when possible, I will also assign readings from an alternative textbook (with a scope closer to the scope of this course, but that does not cover some topics that we will cover in class):

- Phillip Kaye, Raymond Laflamme, Michele Mosca. *An introduction to quantum computing.* Available online via the uOttawa library `http://orbis.uottawa.ca/record=b3584631~S0*eng`.

Grade Distribution:

	MAT 4996	MAT 5991
Assignments	20%	20%
Project	—	15%
Midterm Exam	30%	25%
Final Exam	50%	40%
TOTAL	100%	100%

Letter Grade Distribution: Based on the course evaluations, your final letter grade will be obtained by truncating your cumulative average, and then converting according to the following scheme: A+: 90–100; A: 85–89; A-: 80–84; B+: 75–79; B: 70–74; C+: 65–69; C: 60–64; D+: 55–59; D: 50–54; E: 40–49; F: 0–39.

Important Dates

First class:	Sept. 5
Last class:	Dec. 2
Reading week (no class):	Oct. 13–17
Midterm: (in class)	Oct. 10
Final Exam:	TBD (during the final exam period)
No office hours (AB not available):	Nov. 11, Nov. 25

Assignments will generally posted on Friday and due on the following Friday. There will be approximately 5-6 assignments, thus more or less one every two weeks.

MAT 5991 (graduate-level course)

- *Registration:* Mathematics graduate students must obtain permission to register in the 5991-level course. This is done via the "Reading Course Request Form", which you must bring to me so I can verify your background and sign. The form is then submitted to the Director of Graduate Studies in Mathematics and Statistics (Benoit Dionne). Following the approval of the request by the Director of Graduate Studies in Mathematics and Statistics, the reading course will be created on Rabaska and the student will be able to register to this course at the office of Lorraine Houle (Academic Officer).

  For Physics graduate students, the process is somewhat different. Please consult with your supervisor, and then consult with me about the prerequisites for the course. After this, the reading course will be created on Rabaska and the student will be able to register to this course at the office of Lorraine Houle (Academic Officer).

- *MAT 5991 evaluation:* You will be graded on the same assignments, midterm and final exam as MAT4996, but may be asked to answer more questions and show a higher level of comprehension than the 4996-level students. In addition, you will be graded on a project, that will consists in both a written and oral component. Details are provided in a separate document.

Further course information:

1. **Exams:**
   - The midterm and exam are closed book, closed notes.
   - **No makeup midterm will be given.** Students with an accepted medical note will be allowed tranfer the weight of the midterm evaluation to the final.
2. **Preparing your solutions:** In all work that you submit (assignments, midterms, exam, etc.), your answers will be evaluated according to your problem-solving process. This means that *you must show all your work*. It is not sufficient to simply state an answer. You will be graded on the clarity, conciseness and accuracy of your entire process of finding a solution.
3. **Collaboration:** Students are expected to work on assignments independently. Discussion amongst students is encouraged, but each student must write up his or her own solution. If you have extensively consulted a reference in order to prepare your solution, you must cite this reference.
4. **Academic Integrity:** Academic fraud is an act by a student that may result in a false academic evaluation of that student or of another student. You are responsible for being aware of the University Regulation to this effect: `http://web5.uottawa.ca/admingov/regulation_13.html`. *Do not get caught cheating!* When in doubt, direct your questions to the professor or teaching assistant.
5. **Attendance:**

   I expect that you will attend class. In the event that this is not possible, please note that students are responsible for all missed work, regardless of the reason for absence. It is also the absentee's responsibility to get all missing notes or materials.