COMP 598
Introduction to Quantum Communication Theory
Winter 2011

Instructor: Dr. Mark M. Wilde, Phone number: 514-398-7071 ext. 00115, email: mwilde ((at)) gmail ((dot)) com

Time and Location: Tuesdays and Thursdays 1:05-2:25pm, Room: McConnell 320.

Office Hours: after class or by appointment

Required Textbook: *Quantum Shannon Theory* Lecture Notes, Mark M. Wilde
Notes are available at `http://markwilde.com/teaching/`
Recommended Textbooks: *Quantum Computation and Quantum Information*, Michael Nielsen and Isaac Chuang.
Elements of Information Theory, Thomas M. Cover and Joy A. Thomas

Prerequisites: Linear Algebra and Probability Theory (ECE 203 or equivalent). Exposure to Real Analysis, Information Theory, or Quantum Mechanics is helpful but not required.

Material: This course introduces the subject of communication with quantum systems. Quantum information theory exploded in 1994 when Peter Shor published his algorithm that can break RSA encryption codes. Since then, physicists, mathematicians, and engineers have been determining the ultimate capabilities for quantum computation and quantum communication. In this course, we study the transmission of information over a noisy quantum communication channel. This course is intended for adventurous minds. There are many aspects of this new field that have not yet been explored. If you take this course, you could develop the mental discipline to contribute to this exciting field in the early stage of its development.

Grading: There will be five assignments and a final presentation.

Assignments	75%
Presentation	25%.

Presentation: The final presentation will be a useful way for the students to become more familiar with some of the research topics in the quantum information literature.

Week 1	**Week 8**
Overview of Quantum Shannon Theory Overview of Information Theory	Weak Classical Typicality Strong Classical Typicality (Ctd.)
Week 2	**Week 9**
Data Compression and Channel Capacity The Noiseless Quantum Theory	Quantum Typicality and Schumacher Compression Packing Lemma
Week 3	**Week 10**
The Noisy Quantum Theory The Purified Quantum Theory	Packing Lemma (Ctd.) The Classical Capacity
Week 4	**Week 11**
A Classical and Quantum Error-Correction Code Three Noiseless Quantum Protocols	Covering Lemma The Private Capacity
Week 5	**Week 12**
The Unit Resource Capacity Region Coherent Communication	The Quantum Capacity The Quantum Capacity (Ctd.)
Week 6	**Week 13**
Distance Measures Distance Measures (Ctd.)	Resource Inequalities and the Family Tree Unification of Quantum Shannon Theory
Week 7	
Information and Entropy Information and Entropy (Ctd.)	