PHYS 7895
Introduction to Quantum Information Theory
Fall 2015

Instructor: Prof. Mark M. Wilde, Phone number: (225) 578-4323

Time and Location: Monday and Wednesday 12:00pm-1:20pm, Room: Nicholson 435.

Office Hours: Monday 1:30pm-2:30pm and Thursday 11am-12pm in Nicholson 447

Required Textbook: *Quantum Information Theory*, Mark M. Wilde
Please use the version available at `http://markwilde.com/qit-notes.pdf`

Prerequisites: Linear Algebra and Probability Theory. 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. In particular, you will learn about quantum mechanics, entanglement, teleportation, entropy measures, and various capacity theorems involving classical bits, qubits, and entangled bits.

Grading: There will be five assignments and a final presentation. You are also required to scribe two or more lectures, depending on the class size.

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.)	