PHYS 7347
Quantum Information Theory
Fall 2021

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

Time and Location: Monday, Wednesday, Friday 12:30pm-1:20pm, Room: Nicholson 106

Office Hours: Mondays from 4-5pm in Nicholson 447

Required Textbook: *Principles of Quantum Communication Theory: A Modern Approach*, by Sumeet Khatri and Mark M. Wilde

Please use the version available at `http://markwilde.com/PQCT-khatri-wilde.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 assignments due every two weeks and a final presentation.

Assignments	75%
Presentation	25%.

Homeworks are due by 4pm on Wednesday Sept. 8, Sept. 22, Oct. 6, Oct. 20

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: Introduction to QIT, mathematical tools
Week 2: Semi-definite programming
Week 3: Quantum states and measurements
Week 4: Quantum channels
Week 5: Fundamental quantum information processing tasks
Week 6: Distinguishability measures for states and channels
Week 7: Quantum entropies and information
Week 8: Quantum entropies and information (ctd.)
Week 9: Entanglement measures
Week 10: Entanglement-assisted classical communication
Week 11: Classical communication
Week 12: Entanglement distillation
Week 13: Quantum communication
Week 14: Secret key distillation and private communication