Introduction to Quantum Information Processing

QIC 710 / CO 681 / AMATH 871 / CS 768 / PHYS 767

Fall 2018

Instructor: Professor Jon Yard (QNC 3126, jyard@uwaterloo.ca)

Prerequisites: MATH 235 or equivalent (e.g. PHYS 364 & 365), STAT 230 or equivalent. Familiarity with linear algebra concepts such as unitary and Hermitian matrices over the complex numbers.

Lectures: Tuesdays and Thursdays from 11:30-12:50 in MC 4040

First lecture: Thursday, September 6

Objective: The purpose of this course is to introduce the mathematical theory of quantum information processing (also known as quantum computing) at the graduate level.

Intended audience: This course is primarily intended for graduate students in AMATH, CS, C&O or Physics. Other students may take this course with the permission of the instructor.

Topics to be covered include:

• Introduction to the quantum information framework
• Quantum algorithms (including Shor’s factoring algorithm and Grover’s search algorithm)
• Computational complexity theory
• Density matrices and quantum operations
• Distance measures between quantum states
• Entropy and noiseless coding
• Quantum error-correcting codes and fault-tolerance
• Non-locality
• Quantum cryptography

Evaluation:
5 assignments 12% each
1 project 40%