

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%