4782-Quantum Information, quantum computing (Fall 2013)

MATH 4782, PHYS 4782
Instructor: Jean Bellissard

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Lectures	Skiles 269 Tuesday-Thursday 1:35-2:55pm
Course listed jointly with	MATH 4782 AG, CRN 90251 MATH 4782 AU, CRN 90252 PHYS 4782 A, CRN 90383
Office Hours	Tuesday 11:00-11:55am or *by appointment* Skiles 132

Calendar of the Week

(to calendar)

Homework #2 due Tuesday September 17, 4:35pm
Report Proposal due Thursday September 19
(see)

- **September 17-19:** Phase estimate, order finding Schor's algorithm *QCQI Sections 5.2-5.3*
- **September 24-26:** Shor's & Quantum Search algorithm, *QCQI Section 5.3, 6.1-6.2*

- ***Homework #3:***

1)- Read carefully QCQI, Section 5; in particular read the Boxes # 5.2 & 5.3

Calendar of the Week

(to calendar)

together with Sections 2.2-2.5 & 6.1-6.2
2)-Treat as many exercises as possible in Section 5
3)- Read and learn Boxes # 2.3, 2.4
4)-Turn in exercises (*to be graded*) # 5.1, 5.4, 5.12, 5.13, 5.17
and (*not graded*) #2.57, 2.58, 2.61, 2.71, 2.73, 5.6, 5.8, 5.10, 5.11, 6.2, 6.3, 6.7, 8.4, 8.6
Due Date: Tuesday October 15th, 2013

Course Outline and Scheduling

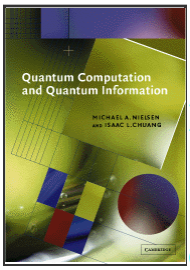
Topic	Text Sections	Estimated Date
What is a qbit ? 1-qbit gates, 1-qbit states	QCQI Sections 1.2 & 2	Aug. 20-22
N-qbits,entanglement, Bell's inequalities	QCQI Sections 1.3 & 2	Aug. 27-29
Q-Mechanics & Quantum Circuits,	QCQI Sections 2.2 & 4	Sept. 3-5
Quantum Fourier transform	QCQI Section 5.1	Sept. 10-12
Phase estimate, order finding Schor's algorithm	QCQI Section 5.2 & 5.3	Sept. 17-19
Shor's & Quantum Search algorithm	QCQI Section 5.3, 6.1 & 6.2	Sept. 24-26
Experiments *(invited guest)*		Oct. 1-3
Measurement I, II,	QCQI Section 8	Oct. 8-10 & 17 *(Fall Recess Oct 15)*
Measurement III, IV	QCQI Section 8	Oct. 22-24 & 29-31
Trace distance, Fidelity	QCQI Section 9	Nov. 5-7

Topic	Text Sections	Estimated Date
Quantum Error correction I, II, III, IV	QCQI Section 10	Nov. 12 *till* Dec. 5 *(Thanksgiving Nov. 28)*

Prerequisites

MATH 2401: familiarity with matrix calculus and finite dimensional vector spaces.

Textbooks



Quantum Computation and Quantum Information (QCQI)
by Michael A. Nielsen, Isaac L. Chuang
Cambridge University Press; 10 Anv edition (January 31, 2011)

Homeworks

(to calendar)

Students will be required to turn in a series of homework periodically.
Please check the web page weekly.
Homeworks will be graded.
They will count for 25% in the final grade

Report

(Report Instructions)

Each student must write a 30-35 pages report *(see instructions)*

Submission: *Thursday September 19, 2013*

Progress Report: *Thursday October 24, 2013*

Final Report: *Tuesday December 3, 2013*

Final Exam

Tuesday December 10, 2013, 2:50-5:40pm Skiles 269

- ***Program:*** All Sections of QCQI treated in class during the Fall semester 2013.

Final Grade ***Grade Distribution***

Final Grade		***Grade Distribution***
Homeworks	25%	90% for an A
Report	35%	80% for a B
Final	40%	70% for a C
		60% for a D

Course Description

Quantum Mechanics is the law of nature governing very small systems. Such systems, like electrons, atoms, nuclear spins, photons, are liable to store and transmit information. Such small quantum systems do not couple easily to the rest of the world, so that they evolve with no loss of information as long as no measurement is made on them. It is thus, in principle, possible to make such a system compute for us, much faster than any available computer and have the loss of information only at the very end, while retrieving the result. The aim of the course, opened to students coming from various areas, is to introduce them to quantum computing with a minimal amount of perequisites. By lack of time, the content of the course, however will not treat fully some important aspects of quantum computing such as physical realizations, (QCQI Section 7) or quantum information theory (QCQI Section 11) which will only be introduced and superficially developed.