4782-Quantum Information, quantum computing (Fall 2009)

MATH 4782, PHYS 4782, CS4803
Instructor
Jean Bellissard
Professor of Mathematics and Physics
School of Math, Skiles 132 , Physics Howey W511
Phone: (404) 385-2179 (Math), 404-385-2509 (Phys)
Fax: (404) 894-4409
e-mail: jeanbel@math.gatech.edu

Location Skiles 243 Tuesday-Thursday 1:35-2:55am

Course listed jointly with
MATH 4782 AG CRN 86823
MATH 4782 AU CRN 86824
PHYS 4782 A CRN 86992
CS4803 QIC CRN 89398

Office Hours: Skiles 132 By appointement
Dates: August 18 *till* December 3, 2009

Final Report is due on Monday Nov 30th

(instructions ⇨, report ⇨)

(Final Exam: training exercises ⇨)

- November 17th & 19th: Quantum Error Corrections II, *QCQI Sections 10*
- November 24th: (*Thanksgiving on 26th*) Quantum Error Corrections III, *QCQI Sections 10*
- December 1st & 3rd: Quantum Error Corrections IV, *QCQI Sections 10*

- ***Homework 6*** :

1)- Read carefully *Nielsen-Chang*, Sections 9-10.1-10.3
2)- Treat as many exercises as possible
3)- Turn in exercises (*will not be graded*) # 9.3, 9.5, 9.8, 9.10, 9.15, 9.17, 9.18, 9.22, 10.3, 10.4, Pb 9.1
Due date : Thursday December 1st, 1:35PM

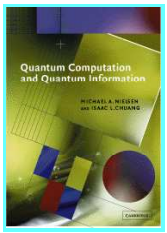
- ***News*** ⇨ *(see news)*

Course Outline and Scheduling *(see ⇨)*

Topic	Text Sections	Estimated Date (2009)
What is a qbit ? 1-qbit gates, 1-qbit states	QCQI Sections 1.2 & 2	Aug 18-20
N-qbits,entanglement, Bell's inequalities	QCQI Sections 1.3 & 2	Aug 25-27
Principles of QMechanics & Quantum Circuits,	QCQI Sections 2.2 & 4	Sept 1-3
Experiments: introduction *(invited guest)*		Sept 8-10
Quantum Fourier transform	QCQI Sections 5.1	Sept 15-17
Phase estimate, order finding Schor's algorithm	QCQI Section 5.2-5.3	Sept 22-24
Shor's & Quantum Search algorithm	QCQI Section 5.3, 6.1-6.2	Sept 29-Oct. 1

Measurement I, II,	QCQI Section 8	Oct 8-13-15 *(oct 5-6 recess)*
Measurement III, IV	QCQI Section 8	Oct 20-22 & Oct 27-29
Trace distance, Fidelity	QCQI Section 9	Nov 3-5
Quantum Error correction I, II, III, IV	QCQI Sections 10	Nov10 till Dec 3 *(nov 26 Thanksgiving)*

- ***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 Univ Press, (2000)

- ***Homework*** Students will be required to turn in a series of homework periodically.
  Please check the web page weekly.
  The homeworks will be graded.
  They will count for 25% in the final grade.
- ***Report*** Each student must write a 30-35 pages report (see instructions ⇨)

  Submission: *Thursday September 17th 2009* ⇨

  Progress Report: *Thursday October 22nd 2009* ⇨

  Final Report: *Monday November 30th 2009* ⇨
- ***Final Exam*** *December 11, 2009*
  11:30am-2:20pm Skiles 243

  Program : All Sections treated in class during the Fall semester 2009,
  except Sections 7 & 11, in the Book
  Quantum Computation and Quantum Information
  (by Michael A. Nielsen, Isaac L. Chuang . Cambridge Univ Press, (2000))

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 q*uantum information theory* (QCQI Section 11) which will only be introduced and superficially developed.

For an overview see

- Two Lectures on "Quantum Computing"
  "I: Introduction. Qubits, Quantum circuits (pdf) "
  (PowerPoint version 0.4MB)
  "II: Algorithms, Error-correcting codes, Physical Realizations (pdf)"
  (PowerPoint version 0.7MB)
  delivered at Georgia Institute of Technology,
  School of Mathematics, Atlanta, GA, October 15 & 29, 2003

- Lecture Quantum Computing: what is it ? Power Point file
  School of Mathematics, Georgia Institute of Technology, Thursday March 6, 2008

References: books, articles (these references have not been updated since 2005)

Useful Links (these links have not been updated since 2004)

Return to top