FEO3340 Quantum Information Theory 12.0 credits

Kvantinformationsteori

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FEO3340 valid from Autumn 2016

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

A student who has passed this course should be able to:

Describe and understand the mathematical theory of (infinite-dimensional) Hilbert space

Describe and understand the fundamentals of the mathematical representation of Hilbert space quantum

mechanics

Describe and understand how classical information can be represented, stored and conveyed through

quantum mechanical phenomena, such as entanglement

Describe and understand the basics of quantum computation

Describe and understand quantum information metrics, such as von Neumann entropy, and acquire

working knowledge in applying these metrics to the analysis of physical information systems

Describe and understand the fundamental bounds for information compression and transmission in

quantum systems, and acquire working knowledge in applying these metrics to the analysis of physical

information systems

Describe, understand and implement algorithms for quantum compression and error-correction coding

Describe, understand and implement protocols for quantum cryptography

Course contents

The course does not require working knowledge in quantum mechanics, although having studied the topic

in undergrad physics will be helpful. The course assumes however working knowledge in information theory,

corresponding to the course EQ2840 Information Theory and Channel Coding (FEO3210 Information

Theory).

The main text for the course is “Quantum Computation and Quantum Information” by Nielsen and

Chuang, Cambridge Univ. Press 2000 & 2010. Course notes/slides plus complementing material freely

available on the Internet will also be used.

Lecture 1: The mathematical description of quantum mechanics

Lecture 2: Quantum mechanics and quantum bits

Lecture 3: Composite systems and entanglement

Lecture 4: The quantum density operator

Lecture 5: Quantum noise and quantum operations

Lecture 6: Distance and entropy measures

Lecture 7: Compression

Lecture 8: Classical information over noisy quantum channels

Lecture 9: Quantum error-correction coding

Lecture 10: Quantum error-correction coding

Lecture 11: Quantum cryptography

Lecture 12: Quantum computation

Disposition

Each lecture will be a 3 hours meeting, where the first 1.5 hours are a lecture, in seminar format, given by

the course responsible, and where the second 1.5 hours are a ticking session to go through the homework

problems assigned in the previous meeting.

Course literature

The main text for the course is “Quantum Computation and Quantum Information” by Nielsen and

Chuang, Cambridge Univ. Press 2000 & 2010. Course notes/slides plus complementing material freely

available on the Internet will also be used.

Examination

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

The students will be examined based on mandatory homework problems. A written or oral exam will

be offered subsequently in cases where the homework problems do not provide sufficient proof that the

learning outcomes have been met.

Other requirements for final grade

80% of the mandatory homework assignments solved, checked in ticking sessions, or

written take-home exam passed

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.