MICRO-435

Quantum and nanocomputing

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Cursus	Sem.	Type
Microtechnics	MA1, MA3	Opt.
Minor in Quantum Science and Engineering	H	Opt.
Quantum Science and Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Courses	4 weekly
Exercises	2 weekly
Number of positions	

Summary

The course teaches non von-Neumann architectures. The first part of the course deals with quantum computing, sensing, and communications. The second focuses on field-coupled and conduction-based nanocomputing, in-memory and molecular computing, cellular automata, and spintronic computing.

Content

The topics covered by the course are summarized as follows:

- Fundamentals of quantum computing
- Qubit realization & control
- Cryo-CMOS components
- Scalable quantum computers
- Quantum communication, sensing, and metrology
- Nanocomputing based on conduction
- Field coupled nanocomputing (FCN)
- Logic in memory based on magnetic FCN
- BioMolecular Computing
- (Bio)Memristors

Keywords

Qubit, quantum stack, von Neumann architectures, biomolecular computing, memristors, logic-in-memory, conduction-based computing

Learning Prerequisites

Required courses

- Basic mathematics/physics

Recommended courses

- Basic quantum mechanics
- Solid-state devices
- CMOS circuit design

Learning Outcomes

By the end of the course, the student must be able to:

- Generalize basic concept of a quantum computer
- Develop simple algorithms
- Design cryo-CMOS circuits and systems
- Contextualise the control and readout of spin qubits
- Elaborate basics of in-memory computing, molecular computing, memristors, and conduction-based computing

Assessment methods

On-going assesment through homework
Final examination

Resources

Bibliography

- N.D. Mermin, â##Quantum Computer Science: An Introduction,â## Cambridge University Press, 5th printing, 2016. ISBN 978-0-521-87658-2
- M.A. Nielsen, I.I. Chuang, â##Quantum Computation and Quantum Informationâ##, Cambridge Press, 3rd printing, 2017. ISBN 978-1-107-00217-3

Ressources en bibliothèque

- Find the references at the Library

Moodle Link

- https://go.epfl.ch/MICRO-435