

Quantum Computing					
Module-No./Abbreviation	Credits	Workload	Term	Frequency	Duration
CE-WP21/QC	6 CP	180 h	3 rd Sem.	Winter term	1 Semester
Courses			Contact hours	Self-Study	Group Size:
Quantum Computing			4 SWS (60 h)	120 h	No Restrictions
Prerequisites					
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Learning goals / Competences:					
After successfully completing the module, the students					
<ul style="list-style-type: none"> • are enabled to design and create programs for quantum computers, • can critically evaluate quantum systems and quantum algorithms, • can assess the benefit of using quantum effects in computations. 					
Content					
The lecture covers the theory and application of quantum computing from a computer science perspective with a focus on the usage of today's quantum hardware.					
The relevant basics of quantum mechanics including superposition, measurement, interference, entanglement and mathematical notation are introduced. The characteristics of quantum bits and registers are discussed, and the construction and properties of quantum gates and quantum circuits presented. Prominent examples for quantum algorithms are surveyed including algorithms based on quantum Fourier transformation (e.g. Shor's factoring), quantum search (e.g. Grover) and quantum solution of linear systems of equations (e.g. HHL). Current quantum computer hardware, including gate-based and adiabatic quantum computers, as well as quantum error correction are discussed.					
An introduction to quantum programming languages and environments will be provided. Hands-on programming exercises and self-implemented quantum circuits in study projects are used to discuss and illustrate the theoretical content. Implementations are tested on quantum simulators and cloud-based quantum hardware.					
Teaching methods / Language					
Lecture (2h / week), Exercises (2h / week) / English					
Mode of assessment					
Study project and oral examination					
Requirement for the award of credit points					
Passed final project and passed oral examination					
Module applicability					
MSc. Computational Engineering					
Weight of the mark for the final score					
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Module coordinator and lecturer(s)					
Prof. Dr. A. Vogel, Assistants					
Further information					