## Quantum algorithms -- questions for the exam

- 1. Qubit: state space, Bloch sphere representation
- 2. Reversible logic: Fredkin and Toffoli gates, universality
- 3. Basic 1-qubit quantum gates I, X,Y, Z
- 4. Rotation operators in 1-qubit space
- 5. How to construct arbitrary rotation  $R_n(\theta)$
- 6. Gates H, S and T
- 7. Representing arbitrary 1-qubit unitary operation by a sequece of rotations
- 8. C-not and CC-not gates
- 9. Controlled H gate: operation and matrix representation
- 10. A simple circuit generating Bell states
- 11. Controlled 1-qubit unitary operations
- 12. Quantum teleportation protocol
- 13. No-cloning theorem
- 14. Quantum measurement (single qubit in computational and in diagonal basis)
- 15. Constructing a reversible unitary operator for an arbitrary classical logic function  $F:\{0,1\}^n \rightarrow \{0,1\}$
- 16. Deutsch-Jozsa problem
- 17. Simon's problem
- 18. Classical RSA algorithm and its security
- 19. Reduction of the factorization problem to order-finding
- 20. Quantum Fourier transform
- 21. Circuit representation of QFT
- 22. Phase estimation problem
- 23. Operator U used in order finding algorithm
- 24. Quantum circuit for order finding
- 25. Possible failures of a single run of Shor's algorithm
- 26. Construction of Grover's operator G used in quantum search
- 27. Grover's quantum search algorithm and its complxity