EEE 6516 Quantum Computing

Lecture plan · Sajid Muhaimin Choudhury · https://sajidlab.org

Twenty lectures of 75 minutes in nine chapters, two lectures per week, after an introductory class in Week 1. Week 7 is a midterm-assignment week and Week 13 is for final-project presentations.

Week	Unit	Title	Topics	Outcomes	Readings
1	L00	Introduction to quantum computing and to the course	Introduction to quantum computing and to the course (course page, Weekly Plan) (published)	Not stated	Not stated
2	L01	Why quantum computing	Why quantum computing: bits vs qubits, landscape, course and toolchain	Not stated	Chapter 1 handout
2	L02	Complex vector spaces for engineers	Complex vector spaces for engineers: Dirac notation, operators, eigenvalues	Not stated	Chapter 1 handout
3	L03	Postulates I	Postulates I: states, superposition, the Born rule, measurement	Not stated	Chapter 2 handout
3	L04	Single-qubit gates and the Bloch sphere; evolution under a Hamiltonian	Single-qubit gates and the Bloch sphere; evolution under a Hamiltonian	Not stated	Chapter 2 handout
4	L05	Observables, expectation values, measurement bases; sampling and shot noise	Observables, expectation values, measurement bases; sampling and shot noise	Not stated	Chapter 2 handout
4	L06	Composite systems	Composite systems: tensor products, ordering conventions, two-qubit gates	Not stated	Chapter 3 handout
5	L07	The circuit model	The circuit model: measurement, universality, reversible logic, transpilation; the same circuit in Qiskit, Cirq and PennyLane	Not stated	Chapter 3 handout
5	L08	Entanglement	Entanglement: Bell states, no-cloning, Bell measurement	Not stated	Chapter 4 handout
6	L09	Teleportation, superdense coding and the CHSH inequality	Teleportation, superdense coding and the CHSH inequality	Not stated	Chapter 4 handout
6	L10	Oracles and phase kickback	Oracles and phase kickback: Deutsch, Deutsch–Jozsa, Bernstein–Vazirani	Not stated	Chapter 5 handout
8	L11	Grover search and amplitude amplification	Grover search and amplitude amplification	Not stated	Chapter 5 handout
8	L12	The quantum Fourier transform	The quantum Fourier transform	Not stated	Chapter 6 handout
9	L13	Quantum phase estimation	Quantum phase estimation	Not stated	Chapter 6 handout
9	L14	Order finding and Shor’s algorithm	Order finding and Shor’s algorithm	Not stated	Chapter 6 handout
10	L15	Density matrices, partial trace, the Bloch ball	Density matrices, partial trace, the Bloch ball	Not stated	Chapter 7 handout
10	L16	Quantum channels and noise; T1/T2; noisy simulation	Quantum channels and noise; T1/T2; noisy simulation	Not stated	Chapter 7 handout
11	L17	Error correction	Error correction: repetition codes, syndromes, the Shor code	Not stated	Chapter 8 handout

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Week	Unit	Title	Topics	Outcomes	Readings
11	L18	Stabilisers, the surface code and fault tolerance	Stabilisers, the surface code and fault tolerance	Not stated	Chapter 8 handout
12	L19	Superconducting qubits from the harmonic oscillator	Superconducting qubits from the harmonic oscillator	Not stated	Chapter 9 handout
12	L20	Trapped ions, photons, neutral atoms and spins; comparing platforms	Trapped ions, photons, neutral atoms and spins; comparing platforms	Not stated	Chapter 9 handout

Slides are published lecture by lecture after copyright clearance; the plan may be adjusted during the term.

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