Content

This advanced course assumes familiarity with the basics of quantum computing, and the underlying mathematics, specifically linear algebra over complex vector spaces. This check-list provides a list of the basic mathematical concepts you should be familiar with. Pages 61-80 of Nielsen & Chuang's "Quantum Information and Quantum Computation" cover the majority of materials, using the Dirac (or bra-ket) notation customary in quantum computing. We highly advise you read those 19 pages. For these basic concepts, Wikipedia also offers solid explanations.

Checklist

1. The field of complex numbers: Real and imaginary parts of a complex number. Addition, multiplication and functions of complex variables. Euler formula. Representation in the complex plane. Conjugate of a complex number and absolute value.

2. (Complex) Vector spaces, esp. $\mathbb{C}^n$. Dimension and basis.

3. Inner product (unitary spaces), vector norm (Euclidean), orthogonality, orthonormal basis. Subspaces.

4. Linear operators, numerical representations (matrices, matrix-matrix and matrix-vector products); Unitary operators (matrices). Hermitian matrices. Projections.

5. Eigenvalues, eigenvectors. Spectral theorem and spectral decomposition.

6. Functions of operators.

7. Dirac notation (bra-ket, braket) notation

8. Tensor product (or: Kronecker product) of spaces, vectors and operators (matrices).

9. Miscellaneous: basics of probability theory. Expectation values