Elective: Introduction to Quantum computing

Course Objectives: A basic introduction to quantum mechanics, linear algebra and familiarity with the Dirac notation is provided first to get one's quantum moorings right . This is then followed byan introductory treatment of quantum computation and quantum information covering aspects of quantum entanglement, quantum algorithms, quantum channels. Rudimentary quantum computing is introduced using the IBM quantum computer and associated simulators

Syllabus

Module I

Introduction: Elementary quantum mechanics:, linear algebra for quantum mechanics,Quantum states in Hilbert space,The Bloch sphere, Density operators, generalized measurements, no-cloning theorem.

Module II

Quantum correlations: Bell inequalities and entanglement, Schmidt decomposition, super-dense coding, teleportation.

Module III

Quantum cryptography: quantum key distribution

Module IV

Quantum gates and algorithms: Universal set of gates, quantum circuits, Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, factoring

Module V

Programming a quantum computer: The IBMQ, coding a quantum computer using a simulator to carry out basic quantum measurement and state analysis.

Text-books

(1) Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University press, 2007.

(1) Chris Bernhardt, Quantum Computing for Everyone, The MIT Press,Cambridge, 2020

(2)David McMahon-Quantum Computing Explained-Wiley-Interscience , IEEE Computer Society (2008)

References

(1) Quantum Computation and Quantum Information, M. A. Nielsen &I.Chuang, Cambridge University Press (2013).

(2) Quantum Computing, A Gentle Introduction , Eleanor G. Rieffel and Wolfgang H. Polak MIT press (2014)