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| Title | ***Quantum Computation*** | Number | QCL6XX0 |
| Department | IDRP (QC) | L-T-P [C] | 3–0–0 [3] |
| Offered for | MTQT | Type | Compulsory |
| Prerequisite | | | |

**Objectives**
The instructor will:
1. Provide fundamentals of quantum information and computation
2. Impart the knowledge of modeling efficiencies of a protocol in real experimental conditions

**Learning Outcomes**
The students are expected to:
1. Use the concepts taught in class to various aspects of quantum information and computation
2. Understand and appreciate the technological evolution at theoretical and experimental fronts in QIC

**Contents**
*Quantum-Circuit Model [14 Lectures]:* Classical versus quantum computing- units, Gates and unitary operations, Reversible versus irreversible gates, The joy of superposition and entanglement, Clauser-Horne-Shimony-Holt inequality as a nonlocal game, single and multi-qubit operations, Measurements, Quantum circuits for large networks, Implementing multi-qubit gates, Universal quantum gates, Quantum computation models
*Quantum Algorithms [14 Lectures]:* Quantum Coin—Deutsch's Algorithm, Deutsch-Jozsa and Bernstein-Vazirani Algorithms, Simon's Algorithm, Phase estimation and quantum Fourier transform, Eigenvalue estimation, The order-finding problem, Shor's algorithm, Grover's search algorithm
*Physical Implementation [6 Lectures]*: Requirements- Preparation of initial states, Performance and limitations of unitary operations, Measurements, fidelity, Technological candidates for quantum computing, limitations and drawbacks
*Quantum Error Correction [8 Lectures]*: The need for quantum error correction, bit-flip and phase-flip codes, Shor code, Calderbank-Shor-Steane codes, Stabilizer codes, Fault tolerant quantum computation.

**Textbooks**
1. Nielsen, M. A. and Chuang, I. L., (2000) *Quantum Computation and Quantum Information*, 10th edition, Cambridge University Press.
2. Vedral, V., (2006) *Introduction to Quantum Information Science,* 1st edition, Oxford University Press

**Reference Books**
1. Bouwmeester, D., Ekert, A. and Zeilinger, A., (2000) *The Physics of Quantum Information*, 2nd edition, Springer.
2. Phillip Kaye, Raymond Laflamme and Michele Mosca, (2006) *An Introduction to Quantum Computing*, 1st edition, Oxford University Press.

**Self Learning Material**
Goswami, D., *Quantum Computing*, *Mathematics for Chemistry,* NPTEL Course Material, Department of Chemistry, Indian Institute of Technology Kanpur
https://onlinecourses.nptel.ac.in/noc18_cy07/preview