**PH552: Quantum Information and Computation (3-0-0:3)**

**Framework of Quantum Mechanics**

The Stern Gerlach experiment, Quantum State and the vector representation, fundamental postulates, operators, basic transformation, multipartite system, Tensor product and entangled state, Cbits and Qbits. **[6L]**

**Qubits**

The Bloch sphere: point on the sphere, orthogonal qubits, point inside the sphere. Qubit projections, Bloch sphere rotations. Single qubit logic gates, multiple qubits, two qubit system and logic gates. The Bell state and EPR paradox. Testing Bell’s inequality. Three qubit system, quantum adder. Quantum Gate: controlled-U gate, controlled-V gate and Toffolic gate.  **[10L]**

**Qubits Measurement**s

Implicit measurement and deferred measurement. Qubits error: Qubit-flips and phase-flips. Qubit error correction. Parallelism: computing and superposition, Deutsch’s algorithm, Grover’s algorithm, and Shor’s algorithm, Entanglement and its measures, No-Cloning theorem, dense coding and quantum teleportation.

**[10L]**

**Quantum Computing**

DiVincenzo criteria and physical realizations. NMR quantum computer, single-spin and multi-spin Hamiltonian, Implementation of gates and algorithms, Qubit tomography. Quantum computing with trapped ions and neutral atoms. **[10L]**

**Text Books and References**

1. O. A. Cross, “Quantum Mechanics and Quantum Computing Notes”, 1st edition, CreateSpace Independent Publishing Platform, 2017.

2. D. McMahon, “Quantum Computing Explained”, Wiley, 2016.

3. M. Nakahara and T. Ohmi, “Quantum Computing: From Linear Algebra to Physical Realizations”, 1st edition, CRC Press, 2008.

4. Vathsan, Radhika, “Introduction to Quantum Physics and Information Processing”, 1st edition, CRC Press, 2015.

5. N. David Mermin, “Quantum Computer Science: An Introduction”, Cambridge University Press, 2007.

6. M. A. Nielsen and I. L. Chuang, “Quantum Computation and Quantum Information”, 10th edition, Cambridge University Press, 2010.