Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NPHD510	QUANTUM COMPUTATION AND INFORMATION	3	0	0	3

Prerequisite: Mathematical Physics, Quantum Mechanics, Statistical Mechanics

Course Objective

To introduce the basic knowledge about quantum computation and information.

Learning Outcomes

On successful completion of this course, students will:

- New dimension of quantum mechanics and its application in computer science
- Information processing based on quantum mechanical principles
- Quantum entanglement and quantum cryptography necessary for ultra-secured information passage

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction:** Single qubit, multiple qbits, quantum gates, quantum circuits, Bell states, Bloch sphere, Density operators, Pure and mixed states, decoherence.	8	Introduction: Single qubit, multiple qbits, quantum gates, quantum circuits, Bell states, Bloch sphere, Density operators, Pure and mixed states, decoherence.
2	**Basics of quantum measurement:** Stern-Gerlach Experiment, Projective measurement, POVM measurement.	5	Because outlandishness of quantum mechanics could be understood through experiments, this unit will provide basic ideas about quantum measurements
3	**Quantum Algorithm:** Introduction to quantum algorithms, Deutsch-Jozsa algorithm, Grover's quantum search algorithm	7	This will help in understanding the basics of quantum algorithms proposed for quantum computers
4	**Quantum Cryptography:** Cryptography, Private key distribution, introduction to quantum cryptography. Quantum key distribution, No-cloning theorem, BB84, B92 protocols. Introduction to security proofs for these protocols. Quantum teleportation	10	This unit helps in understanding underlying principle of secure communication using quantum mechanical methods
5	**Quantum Information:** Introduction to classical and quantum information, Examples of quantum error corrections, Shannon and Von Neumann entropy, Quantum channels and noises, Quantum correlations, EPR paradox, Bell's inequalities, Theory of quantum entanglement. Entanglement of pure bipartite states.	12	This unit focuses on basic difference between classical and quantum information. It helps to understand information processing using quantum mechanical principles, basic techniques, new ideas
	Total	**42**	

Text Books:

1. Quantum Computation and Quantum Information by M. A. Nielsen and I. L. Chuang, Cambridge University Press.

Reference Books:

1 A Short Introduction to Quantum Information and Quantum Computation by M. L. Bellac, Cambridge University Press.
2 Introduction to Quantum Computation and Information, H.-K. Lo, T. Spiller, S. Popescu, World Scientific, 1998
3 Principles of Quantum Computation and Information. Vol. 1, G.Benenti, G. Casati, G. Strini, World Scientific