DSE – 23
Quantum Computing

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
Quantum Computing	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	DSC-01(Programming using Python) , Linear Algebra and Vector Calculus

Learning Objectives:

1. *To Study the structural units of quantum computers of the future, forming an understanding of the differences between quantum bits and classical bits*
2. *To Study of basic quantum logical operations and algorithms for processing quantum information.*

Learning Outcomes:

1. *Understand the basic implications of quantum computing*
2. *The fundamental differences between conventional computing and quantum computing.*
3. *Several basic quantum computing algorithms.*
4. *The classes of problems that can be expected to be solved well by quantum computers.*

Unit-I **(7 Hours)**

Overview of traditional computing, Turing machines, analysis of computational problems, quantum mechanics, Dirac notation and Hilbert Spaces, linear algebra for quantum mechanics, Pauli matrices, Hermitian operators, Tensor products. Qubit, Bloch Sphere, Quantum Computation,

UNIT II **(8 Hours)**

No-cloning theorem, Bell states, Entanglement, quantum teleportation, applications of teleportation, super dense coding, quantum key distribution State of a quantum system, time evolution of a closed system, composite systems, measurement, mixed states.

UNIT-III **(15 Hours)**

Quantum circuit model, quantum gates, Hadamard gate, controlled operations, universal sets of quantum gates, unitary transformations, simulation of quantum systems. Introduction to the IBMQ,

UNIT-IV **(15 Hours)**

Probabilistic versus quantum algorithms, Quantum parallelism, Deutsch algorithm, Deutsch-Jozsa algorithm, Simon's algorithm, Shor's algorithm

References:

1. *Quantum Computation and Quantum Information, M A Nielsen and I L Chuang.*
2. *An Introduction to Quantum Computing, P Kaye, R Laflamme and M Mosca.*

Practicals:

1. Use Qiskit or IBMQ to create a qubit in superposition and visualize it on the Bloch Sphere.
2. Build a quantum circuit to generate an entangled Bell state and verify it using measurement results.
3. Simulate quantum teleportation of a qubit's state using a quantum circuit with entanglement and classical bits.
4. Create a quantum circuit for Deutsch's algorithm and run it to determine if a function is constant or balanced.
5. Use IBMQ or Qiskit to implement basic quantum gates (X, H, Z, CNOT) and observe their effect on quantum states.

DSE – 24
Blockchain and its Applications

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Blockchain and its Applications	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	**NIL**

Learning Objectives:

1. *To cover the basic concepts behind blockchain and present Bitcoin and other cryptocurrencies as the motivation for blockchain technologies.*
2. *To provides a substantive discussion about different technologies behind blockchain and cryptocurrencies.*

Learning Outcomes: