Course Code	Course Title	L	T	P	C
BITE407L	Quantum Computing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To introduce quantum computing concepts and principles.
2. To provide comprehensive understanding and applications of quantum algorithms.

Course Outcomes:

1. Analyze various quantum computing principles and properties.
2. Apply matrix algebra techniques for quantum algorithms.
3. Design Quantum gate and circuit operations
4. Distinguish classical and quantum information theory, and analyse the techniques for quantum algorithms
5. Apply and evaluate quantum algorithms.

Module:1	Introduction	4 hours

Introduction to Quantum Computing – Motivation - Difference between Classical and Quantum Computing - Reversible Computing - Probabilistic Computing - Quantum Properties: Wave Particle Duality – Superposition – Entanglement – Coherence – Measurement.

Module:2	Mathematics of Quantum Computing	6 hours

Matrix Algebra: Basis Vectors and Orthogonality - Inner Product and Hilbert Spaces - Matrices and Tensors - Tensor Product of Vector Spaces - Dirac Notation - Density Operators - Probabilities and Measurements - Measurements in Bases.

Module:3	Quantum Computing Building Blocks	8 hours

Qubits - Bra-Ket Notation - Multi-qubits States - Bloch Sphere Representation - Superposition of Qubits - Quantum Entanglement - Operations on Qubits Quantum Gates: NOT - Hadamard, T, CNOT, Toffoli, Z. - Quantum Measuring and Transforming using Gates - Design of Quantum Circuits.

Module:4	Quantum Information	6 hours

Quantum State Machines - Comparison between Classical and Quantum Information Theory - Bell States - Quantum Teleportation - No Cloning Theorem - Quantum Key Distribution - Quantum Error Correction Codes.

Module:5	Techniques for Quantum Algorithms	6 hours

Quantum Fourier Transform - Phase Kick-back - Quantum Phase Estimation - Quantum Walks.

Module:6	Quantum Algorithms	7 hours

Deutsch-Jozsa Algorithm - Grover's Search Algorithm - Simmon's Periodicity Algorithm - Shor's Algorithm.

Module:7	Quantum Programming Models	6 hours

Quantum Programming Languages - Development Libraries for Quantum Programs - Applications and Quantum Supremacy.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Bernhardt. C., 2019. Quantum computing for everyone. MIT Press.
Reference Books	
1.	Hidary. J.D., 2019. Quantum Computing: An Applied Approach Springer.
2	Nielsen. M.A. and Chuang. I., 2010. Quantum computation and quantum information. Cambridge University Press.
3.	Yanofsky. N.S. and Mannucci. M.A., 2008. Quantum computing for computer scientists. Cambridge University Press.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022