Quantum Computing	3	1	0	complex numbers, Algorithms, data structure

Course Objective: To familiarize students with the concepts of quantum computing.

S. NO	Course Outcomes (CO)
CO1	Understand the Fundamental Principles of Quantum Mechanics and Computing
CO2	Develop Proficiency in Quantum Algorithms and Circuit Design
CO3	Explore Quantum Information Theory and Its Applications
CO4	Evaluate Quantum Hardware Technologies and Address Implementation Challenges

S. NO	Contents	Contact Hours
UNIT 1	Introduction to Quantum Computing: Basics of Quantum Mechanics, Quantum states, superposition, and entanglement. Quantum measurement and operators. Quantum Computation Overview Comparison with classical computing. Quantum vs. classical bits (qubits). Quantum Gates and Circuits Quantum Gates : Single-qubit gates: Pauli-X, Pauli-Y, Pauli-Z, Hadamard, Phase, and T-gates. Multi-qubit gates: CNOT, Toffoli, SWAP. Quantum Circuits	**10**
UNIT 2	Quantum Algorithms: Basic Algorithms Deutsch-Josza algorithm. Grover's algorithm for unstructured search. Shor's Algorithm, Quantum factorization and implications for cryptography. Quantum Fourier Transform (QFT) Applications in quantum algorithms.	**8**
UNIT 3	Quantum Information Theory: Quantum Entanglement Bell states, EPR pairs, and teleportation. Quantum Error Correction Error correction codes: Shor code, Steane code. Quantum Cryptography Quantum key distribution (e.g., BB84 protocol).	**8**
UNIT 4	Quantum Simulation and Optimization Quantum Simulators Simulating quantum systems with quantum computers. Quantum Optimization Algorithms Variational Quantum Eigensolver (VQE), Quantum Approximate Optimization Algorithm (QAOA).	**8**

UNIT 5	Practical Quantum Computing Quantum Programming Languages Qiskit, QuTiP, Cirq, and others. Quantum Computing Frameworks IBM Quantum Experience, Google Quantum AI, Microsoft Quantum Development Kit.	**8**
	TOTAL	**42**

REFERENCES		
S.No.	**Name of Books/Authors/Publishers**	**Year of Publication / Reprint**
1	Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang (2000)	2000
2	Quantum Computing: An Applied Approach" by Jack D. Hidary (2021)	2021
3	Quantum Computation and Quantum Information: 10th Anniversary Edition" by Michael A. Nielsen and Isaac L. Chuang (2010)	2010
4	Quantum Computing: A Gentle Introduction" by Yasir A. Abbas (2021)	2021

B.Tech. Information Technology				
Course code: Course Title	**Course Structure**			**Pre-Requisite**
GPU Computing	**L**	**T**	**P**	Computer Architecture
	3	**0**	**2**	

Course Objective: This course aims to provide a solid understanding of GPU architecture and programming