Reg. No.															

Question Paper Code	13457

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Sixth Semester

Computer Science and Engineering (Cyber Security)

20SCPC602 - QUANTUM ALGORITHM

Regulations - 2020

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	*K – Level*	*CO*
1.	The quantum Fourier transform (QFT) is an essential part of which famous quantum algorithm? (a) Grover's Algorithm (b) Shor's Algorithm (c) Deutsch-Jozsa Algorithm (d) Simon's Algorithm	*1*	*K1*	*CO1*
2.	The computational complexity class BQP (Bounded-Error Quantum Polynomial Time) consists of: (a) Problems solvable by classical deterministic algorithms (b) Problems solvable efficiently using quantum computers (c) Problems that cannot be solved in polynomial time (d) Problems solvable using NP-complete algorithms	*1*	*K1*	*CO1*
3.	How does Grover's Algorithm modify the marked state in each iteration? (a) By increasing its amplitude using phase inversion and diffusion (b) By decreasing its amplitude through randomization (c) By continuously applying the Quantum Fourier Transform (d) By measuring the state in every iteration	*1*	*K1*	*CO2*
4.	If Grover's Algorithm is used to break a symmetric cryptographic key of nnn bits, what is the estimated time complexity? (a) O(n) (b) O(2n/2) (c) O(2n) (d) O(log n)	*1*	*K1*	*CO2*
5.	What is a key limitation of implementing Shor's Algorithm on current quantum computers? (a) Lack of efficient quantum factoring libraries (b) Quantum decoherence and gate fidelity issues (c) Shor's Algorithm is not optimized for practical use (d) Classical computers are still faster for all cases	*1*	*K1*	*CO3*
6.	If Shor's Algorithm is successful, how many factors does it find for a composite number? (a) 1 (b) 2 (c) Multiple factors (d) No guarantee of factors	*1*	*K1*	*CO3*
7.	What type of quantum device is best suited for implementing QAOA? (a) Photonic quantum computers (b) Gate-based quantum computers with mid-circuit measurements (c) Analog quantum simulators (d) Quantum annealers	*1*	*K1*	*CO4*
8.	The Quantum Approximate Optimization Algorithm (QAOA) is mainly used for solving what type of problems? (a) Cryptographic key generation (b) Combinatorial optimization problems (c) Quantum state tomography (d) Quantum error correction	*1*	*K1*	*CO4*
9.	What is the key challenge in implementing Quantum Neural Networks (QNNs) on near-term quantum hardware? (a) High qubit requirements and noise sensitivity (b) The lack of classical machine learning knowledge (c) Inability to handle high-dimensional data (d) Quantum entanglement limitations	*1*	*K1*	*CO5*

10. Which algorithm is commonly used for training QNNs? *1 K1 CO6*
    (a) Quantum Backpropagation Algorithm
    (b) Variational Quantum Eigensolver (VQE)
    (c) Quantum Gradient Descent
    (d) Quantum Approximate Optimization Algorithm (QAOA)

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11. Define quantum entanglement and its significance. *2 K2 CO1*
12. State is the significance of the Hadamard gate in quantum computing. *2 K2 CO1*
13. Discuss is the primary objective of Grover's Algorithm. *2 K2 CO2*
14. State a Grover's Algorithm differ from classical search algorithms. *2 K2 CO2*
15. Why is QFT an essential component of Shor's Algorithm? *2 K2 CO3*
16. Discuss is the probability of Shor's Algorithm successfully finding the period in one run. *2 K2 CO3*
17. State is the role of classical optimization in QAOA. *2 K2 CO4*
18. Define the quantum simulation aid in drug discovery. *2 K2 CO4*
19. Define is Quantum Machine Learning (QML). *2 K2 CO5*
20. Discuss the quantum superposition improve machine learning. *2 K2 CO5*
21. Define the QSVM use quantum measurements for classification. *2 K2 CO6*
22. Justify the Quantum Neural Networks (QNNs) differ from classical neural networks. *2 K2 CO6*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) Explain the role of quantum entanglement in quantum computing. How does it enable quantum teleportation? *11 K3 CO1*

OR

b) Discuss Grover's search algorithm and its significance. *11 K3 CO1*

24. a) Explain in detail about the Grover's Algorithm apply to cryptography, particularly brute-force attacks. *11 K2 CO2*

OR

b) Explain in detail about the number of qubits required for Grover's Algorithm scale with database size. *11 K2 CO2*

25. a) Explain the role of Quantum Phase Estimation (QPE) in Shor's Algorithm. *11 K2 CO3*

OR

b) Why does Shor's Algorithm need a quantum computer to achieve exponential speedup? *11 K2 CO3*

26. a) Explain the significance of quantum simulation and its advantages over classical simulation. *11 K2 CO4*

OR

b) Describe the key challenges in performing quantum simulations on current quantum hardware. *11 K2 CO4*

27. a) Explain in detail about the Quantum Reinforcement Learning (QRL) enhance classical reinforcement learning. *11 K3 CO5*

OR

b) Discuss is the Quantum Approximate Optimization Algorithm (QAOA), and how is it used in machine learning? *11 K3 CO5*

28. a) Explain the working principle of Quantum Support Vector Machines (QSVM) and how it differs from classical SVM? *11 K2 CO6*

OR

b) Explain the architecture of Quantum Neural Networks (QNNs) and how they differ from classical neural networks. *11 K2 CO6*