Reg. No.															

B.Tech/ M.Tech (Integrated) DEGREE EXAMINATION, MAY 2024
Fourth Semester

21CSE306J – QUANTUM COMPUTATION
(For the candidates admitted from the academic year 2022-2023 onwards)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours Max. Marks: 75

PART – A (20 × 1 = 20Marks)
Answer **ALL** Questions

	Marks	BL	CO	PO
1. What is the radius of Bloch sphere? (A) 4 (B) 3 (C) 2 (D) 1	1	1	1	1
2. Which one of the following represents the unentangled state? (A) $\|Q\rangle=C_1\|10\rangle+C_3\|01\rangle$ (B) $\|Q\rangle=C_1\|00\rangle+C_3\|11\rangle$ (C) $\|Q\rangle=C_1\|11\rangle+C_3\|01\rangle$ (D) $\|Q\rangle=C_1\|11\rangle+C_3\|00\rangle$	1	2	1	2
3. Gates used in Bell circuit are (A) H and X (B) H and Y (C) H and CC NOT (D) H and C NOT	1	1	1	2
4. Identify the state of a bipartite system (A) $C_1\|00\rangle+C_2\|11\rangle$ (B) $C_1\|00\rangle+C_2\|01\rangle+C_3\|10\rangle+C_4\|11\rangle$ (C) $C_1\|0\rangle+C_2\|1\rangle$ (D) $C_1\|01\rangle+C_2\|10\rangle$	1	1	1	2
5. Which rule of quantum circuit is considered wrong? (A) Gates are arranged sequential from left to right (B) Wires represents identity matrix (C) There are loops in circuit (D) There are quantum wires and classical wires	1	1	2	1
6. The outer product from of 'Y' gate is (A) $Y=-i\|0\rangle\langle1\|+i\|1\rangle\langle0\|$ (B) $Y=-i\|0\rangle\langle1\|-i\|1\rangle\langle0\|$ (C) $Y=-i\|0\rangle\langle1\|-i\|1\rangle\langle0\|$ (D) $Y=-i\|0\rangle\langle1\|+i\|1\rangle\langle1\|$	1	1	2	2
7. Identify the θ value of $\|0\rangle$ state (A) π (B) θ (C) $\frac{\pi}{2}$ (D) $\frac{\pi}{4}$	1	2	2	2
8. Which of the following gate transforms computational basis into diagonal basis? (A) X gate (B) Y gate (C) Z gate (D) H gate	1	2	2	2

9. The main advantage that quantum computers have over classical computer is _____. 1 1 3 2

(A) Cost (B) Parallelism
(C) Gates (D) Wires

10. Let f(x) be a single qubit function and f(0) = f(1), then f(x) is known as _____ function. 1 2 3 2

(A) Unique (B) Distributed
(C) Constant (D) Balanced

11. Find the number of parallel operations that can be done on N qubit system? 1 1 3 1

(A) N operations (B) N^2 operations
(C) N(N+1) operations (D) 2^N operations

12. When a state $|x\rangle |y\rangle$ passes through quantum oracle f(x) the output is 1 3 3 2

(A) $|x\rangle |f(x)\rangle$ (B) $|x\rangle |y.f(x)\rangle$
(C) $|x\rangle |y \oplus f(x)\rangle$ (D) $|x\rangle |y\rangle |f(x)\rangle$

13. Which of the following is a quantum key distribution protocol? 1 1 4 1

(A) RSA (B) Shor
(C) BB64 (D) DES

14. Amplitude amplification is a technique used in _____. 1 1 4 2

(A) Shor algorithm (B) Grover's algorithm
(C) Deustch algorithm (D) QKD

15. The state required for quantum teleportation is 1 2 4 2

(A) Mixed state (B) Pure state
(C) EPR pair (D) Qutrit

16. Grover's query complexity for searching special item in a set of size N is 1 2 4 2

(A) O(N) (B) $O(N^2)$
(C) $O(\sqrt{N})$ (D) O(1)

17. The main use of quantum annealers involves _____ problems. 1 1 5 2

(A) Searching (B) Optimization
(C) Factorization (D) Phase estimation

18. Protein folding is an use case of _____. 1 1 5 1

(A) Quantum finance (B) Quantum sensing
(C) Quantum physics (D) Quantum chemistry

19. Acronym for QAOA is 1 1 5 1

(A) Quantum Approximate Optimization Algorithm (B) Quantum Alternating Operator Algorithm
(C) Quantum Approximate Optimization Analysis (D) Quantum Approximate Operator Algorithm

20. What are the quantum properties play a vital role in solving optimization related problems, more effectively? 1 1 5 2

(A) Superposition and interference (B) Superposition and entanglement
(C) Entanglement and interference (D) Entanglement and decoherence

PART – B (5 × 8 = 40 Marks)

Answer **ALL** Questions

		Marks	BL	CO	PO
21. a.	Sketch the bell circuit and derive the maximally entangled states from the circuit.	8	3	1	2
	(OR)				
b.	Let $A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$ and $B=\begin{bmatrix}1\\1\\0\\1\end{bmatrix}$ are two vectors, derive the inner product $\langle A \mid B \rangle$ and outer product $\lvert A\rangle\langle B\rvert$ of A and B.	8	3	1	2
22. a.	Sketch Toffoli gate and compute its density matrix from its outer product.	8	4	2	2
	(OR)				
b.	Prepare a Turning machine program to add 1 to a binary number and given step-by-step sequence to add 1 with 1011.	8	4	2	3
23. a.	Explain quantum parallelism with example.	8	2	3	2
	(OR)				
b.	Illustrate Deutsch Jozsa algorithm to show whether the given function f(x) is constant or balanced.	8	4	3	2
24. a.	Demonstrate the quantum supremacy in unstructured database search in comparison with the classical algorithm.	8	4	4	2
	(OR)				
b.	Sketch a quantum circuit for teleporting a qubit and explain how it helps Alice to transfer her state information to Bob.	8	4	4	2
25. a.	Demonstrate the process of solving optimization problems through quantum annealing.	8	3	5	2
	(OR)				
b.	Discuss about any two use cases in quantum finance.	8	2	5	2

PART – C (1 × 15 = 15 Marks)

Answer **ANY ONE** Question

		Marks	BL	CO	PO
26.	Explain in detail about the geometry of quantum states $\lvert 0\rangle$, $\lvert 1\rangle, \lvert +\rangle, \lvert -\rangle, \lvert i\rangle$ and $\lvert -i\rangle$ with suitable diagrams.	15	4	1	2
27.	Design a quantum half adder and quantum half subtractor circuits and derive their truth tables with explanation.	15	4	3	4

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