29. a.	Prove the following identities (i) $H x H = Z$ (ii) $H z H = X$															12	3	2	2
	(OR)																		
b.	Manipulate the matrix representation of SWAP and Hadamard gate from its outer product form (truth table is must).															12	4	2	2
30. a.	Explain in detail about oracle phase kick hack.															12	2	3	2
	(OR)																		
b.	Construct Deustch algorithm for value n = 1.															12	4	3	4
31. a.	Summarize quantum teleportation and its significance on applications.															12	3	4	4
	(OR)																		
b.	Illustrate the amplitude amplification used for unstructured database search in quantum computing.															12	3	4	2
32. a.	Categorize the different physical realizations of qubit.															12	4	5	4
	(OR)																		
b.	Formulate the need of quantum supremacy and NISQ era through different applications.															12	3	5	2

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Reg. No.															

B.Tech. DEGREE EXAMINATION, MAY 2023
Fifth & Sixth Semester

18CSE310J – QUANTUM COMPUTATION
(For the candidates admitted during the academic year 2018-2019 to 2021-2022)

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 & Part - C** should be answered in answer booklet.

Time: 3 hours Max. Marks: 100

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

	Marks	BL	CO	PO
1. Pauli matrices are not (A) Hermitian (B) Unitary (C) Invertible (D) Non diagonalizable	1	1	1	1
2. The time evolution of quantum state in quantum mechanics is governed by (A) Schrodinger's equation (B) Heisenberg equation of motion (C) Maxwell's equation (D) Heat equation	1	1	1	1
3. Trace of a matrix is (A) Product of Eigen values (B) Inner product of its eigen vectors (C) Negative of the sum of its eigen values (D) Sum of its eigen values	1	1	1	1
4. According to postulates of quantum mechanics 'operators' representing physical observables in quantum mechanics have to be (A) Unitary (B) Symmetric (C) Orthogonal (D) Hermitian	1	2	1	1
5. For $\|\psi\rangle = \cos\left(\frac{\theta}{2}\right)\|0\rangle + e^{i\phi}\sin\left(\frac{\theta}{2}\right)\|1\rangle$ (where $0 \le \theta \le \pi$ and $0 \le \theta \le 2\pi$). It is used to represent any two dimensional quantum state on Bloch sphere. If $\theta = \frac{\pi}{2}, \phi = 0$, which state it represents. (A) $\|0\rangle$ (B) $\left\|\frac{\pi}{2}\right\rangle$ (C) $\|+\rangle$ (D) $\|1\rangle$	1	3	2	2
6. All quantum gates are (A) Irreversible (B) Universal (C) Reversible (D) Non unitary	1	1	2	1

7. NOT gate is called as 1 2 2 1
   (A) X gate (B) Y gate
   (C) Z gate (D) U gate

8. SWAP $|10\rangle$ = 1 2 2 2
   (A) $|11\rangle$ (B) $|01\rangle$
   (C) $|00\rangle$ (D) $|10\rangle$

9. For same input size 'n' which of these has highest run time complexity? 1 2 3 2
   (A) O (1) (B) O (n)
   (C) O (n!) (D) O (n log n)

10. Number of queries used by Deutsch algorithm is 1 1 3 2
   (A) 1/2 (B) 0
   (C) 1 (D) 2

11. Quantum cost is defined as 1 2 3 2
   (A) Number of qubits needed to build the circuit (B) Time needed to perform operation on circuit
   (C) Number of primitive gates needed to create the circuit (D) Number of gates needed to create circuit

12. Classical query complexity of finding whether the function is balanced or constant, for a string size 'n' 1 2 3 2
   (A) 2^n (B) $2^{n-1}+1$
   (C) $\frac{1}{2^n}$ (D) 2^n+1

13. The technique used in grovers algorithm is called 1 1 4 1
   (A) Phase estimation (B) Amplitude amplification
   (C) Period finding (D) Phase finding

14. No cloning theorem states that 1 1 4 1
   (A) There exists no universal copier for quantum states (B) There exists a universal copier for quantum states
   (C) There exists no gate which can copy orthogonal states (D) There exists gate which can copy orthogonal states

15. Grover's algorithm'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)

16. Amplitude amplification includes 1 1 4 1
   (A) Applying oracle and then diffuser (B) Applying diffuser and then oracle
   (C) Appling oracle (D) Applying diffuser

17. Which of these is a quantum key distribution protocol? 1 2 5 2
   (A) Shor (B) BB84
   (C) RSA (D) DES

18. Which part of VQE is done by the classical machine? 1 2 5 2
   (A) Evaluating the cost function (B) Creating the ansatz
   (C) Creating the density matrix (D) Optimization of the cost function

19. Algorithm which is a threat to RSA cryptosystems. 1 1 5 1
   (A) Grover (B) Shor
   (C) Simon (D) Deutsch

20. What technique is necessary to achieve fault tolerant quantum computing? 1 1 5 2
   (A) Quantum Fourier transform (B) Quantum error correction
   (C) Quantum phase estimation (D) Quantum eigen solver

PART – B (5 × 4 = 20 Marks) Marks BL CO PO
Answer **ANY FIVE** Questions

21. Let 4 3 1 2

$$|\phi\rangle = \begin{bmatrix} 2 \\ 6i \end{bmatrix}$$

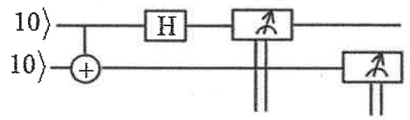
$$|\psi\rangle = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$$

Construct the outer product and tensor product.

22. Explain BRA-KET notations. 4 2 1 2

23. Formulate the matrix representation of CNOT gate. 4 4 2 2

24. Predict the state produced by the following quantum circuit. 4 3 3 2



25. Discuss about quantum amplitude estimation. 4 2 4 2

26. List all the single qubit gates. 4 2 2 1

27. Review any one use case in finance domain with quantum advantage. 4 4 5 2

PART – C (5 × 12 = 60 Marks) Marks BL CO PO
Answer **ALL** Questions

28. a. Compute the Eigen values and eigen vectors of Pauli matrix 'X' and 'Z'. 12 3 1 2

(OR)

b.i. Distinguish between classical system and quantum system. 6 3 1 2

ii. Explain Bell states with circuit diagram. 6 2 1 2