[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7130 **L**

Unique Paper Code : 6203450025

Name of the Paper : Quantum Computing

Name of the Course : **B.Voc Software Development**

Semester : VIII

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. at an appropriate place on receipt of this question paper.
2. Write all the answers in Bengali Language only.
3. Etc ..(as per question paper marks distribution)

Section A

1	a)	Describe the Hadamard gate and its role in creating superposition.	5
	b)	Given: $\|\psi\rangle = \|0\rangle \otimes \|+\rangle$ What is the probability of measuring state $\|01\rangle$?	5
	c)	How does the no-cloning theorem ensure the security of Quantum Key Distribution (QKD)?	5
	d)	Given: $\|\psi_1\rangle = \left(\frac{\sqrt{3}}{2} \quad \frac{1}{2}\right), \|\psi_2\rangle = (0 \; 1)$ Find the tensor product and express the result on a computational basis.	5
	e)	Describe the difference between classical and quantum circuits.	5
	f)	How does the quantum state change with time? Explain using Schrödinger's equation.	5

P.T.O.

Section B

2 a) What are the advantages of quantum algorithms over probabilistic ones? 7

b) What are S and T quantum gates? Explain how they differ in terms of the phase they introduce to a qubit. 8

3 a) Check whether the following composite state is normalized: 7

$$|\psi\rangle = \frac{1}{2}(1\ 1\ 1\ -1)$$

b) Why is the CNOT gate considered a two-qubit gate? 8

Find the output when CNOT is applied to:

$$\frac{1}{\sqrt{2}}(|00\rangle + |10\rangle)$$

4 a) Derive all four Bell states and explain their properties. 7

b) Differentiate between classical information units and quantum information units. Describe the geometrical representation of a qubit. 8

5 a) Explain the concept of unitary evolution in quantum mechanics. Why must all quantum operations be unitary? 7

b) Describe the role of interference in quantum algorithms. How does interference differ from classical probability? 8

6 a) Explain the Deutsch algorithm step-by-step with mathematical formulation. 7

b) Discuss the importance of single qubit gates in quantum computation. 8

7 a) Compare superdense coding with classical communication. Explain the role of entanglement in superdense coding. 7

b) Compute output of circuit: 8

- Input: $|1\rangle$
- Gates: $H \rightarrow Z$