[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7807 **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. The paper has two sections. Section A is compulsory. Each question is of 5 marks.
3. Attempt any four questions from Section B. Each question is of 15 marks.

Section A

1 a) Explain the significance of Hermitian operators in quantum mechanics. 5

b) Differentiate between pure states and mixed states. 5

c) State the no-cloning theorem and prove it mathematically. 5

d) Given: 5

$$|\psi_1\rangle = (1\ 0),\ |\psi_2\rangle = \left(\frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}}\right)$$

- Find the composite state $|\psi_1\rangle \otimes |\psi_2\rangle$.
- Write the result on the computational basis.

P.T.O.

e) Explain the quantum circuit model with a diagram. 5

f) Explain how Schrödinger's equation governs time evolution of a closed system. 5

Section B

2 a) Explain probabilistic vs quantum algorithms in detail. 7

b) Explain the Phase Gate. How is it different from Pauli-Y and Pauli-Z Gates. 8

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

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

b) What is a Controlled-NOT Gate? Draw its diagram. 8

Given:

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

Apply CNOT.

4 a) What are Bell States? Generate the bell states using quantum gates 7

b) Explain the difference between classical bits and qubits. How do we visualize a qubit? 8

5 a) What is the role of quantum gates in a circuit? What is the significance of reversibility in quantum circuits? 7

b) Explain interference and their different types with respect to probability amplitudes. 8

6 a) Explain the Deutsch–Jozsa algorithm step-by-step with equations. 7

b) Explain the working of the Controlled-Z gate with the truth table. What is the output when a CZ gate is applied to $|11\rangle$? 8

7 a) How does teleportation help in quantum computing? Give real-world applications of quantum teleportation. 7

b) Compute inner product: 8

$$\langle\phi|\psi\rangle$$

where:

$$|\phi\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle), |\psi\rangle = \frac{1}{\sqrt{2}}(|0\rangle - |1\rangle)$$