Paper ID : 250369

Subject Code: KCA055

Roll No:

MCA
(SEM IV) THEORY EXAMINATION 2024-25
QUANTUM COMPUTING

TIME: 3 HRS **M.MARKS: 100**

Note: Attempt all Sections. In case of any missing data, choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

Q No.	Question	CO	Level
a.	Define the term quantum.	1	K1
b.	Explain the postulates of quantum mechanisms.	1	`K2
c.	Define the concept of a quantum bit.	1	K1
d.	What are the potential global impacts of quantum computing on cybersecurity?Explain	2	K2
e.	How does a qubit differ from a classical bit regarding information representation? Describe.	4	K3
f.	Discuss thesignificance of quantum parallelism in quantum computation.	3	K3
g.	What are the limitations of current quantum algorithms? Write a justifiable answer.	2	K5
h.	Briefly discuss the Monte Carlo method in detail.	2	K2
i.	Discuss Shannon entropy. Howis it measured?	2	K4
j.	Why is reversibility important in quantum computing? Write a suitable answer.	3	K5

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

Q No.	Question	CO	Level
a.	Describe the role of measurement in a quantum circuit and how it differs from classical measurement.	1	K2
b.	Illustrate a quantum circuit that implements a single qubit rotation followed by a controlled-NOT (CNOT) operation.	2	K3
c.	What is the no-cloning theorem, and how does it influence quantum communication?	3	K2
d.	Compare single orbit operations and control operations in quantum circuits.	2	K4
e.	Evaluate the effectiveness of quantum search algorithms in solving unstructured search problems compared to classical algorithms.	3	K5

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

Q No.	Question	CO	Level
a.	Analyze the advantages and challenges of using nuclear magnetic resonance for quantum computation. Write appropriate answer.	4	K4
b.	Apply the conditions for quantum computation (DiVincenzo criteria) to assess a quantum system's readiness for implementation.	3	K3

4. Attempt any *one* part of the following: 10 x 1 = 10

Q No.	Question	CO	Level
a.	Evaluate the scalability and practicality of different quantum hardware platforms, such as ion traps and optical cavities.	CO3	K5
b.	Demonstrate a hybrid quantum architecture that combines ion traps and optical photon systems for improved stability and coherence.	CO4	K6

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5. Attempt any *one* part of the following: 10 x 1 = 10

Q No.	Question	CO	Level
a.	Discuss the basic working of a harmonic oscillator quantum computer.	1	K2
b.	Compare trace distance and fidelity as measures of closeness between quantum states. Justify your answer with an appropriate example.	2	K5

6. Attempt any *one* part of the following: 10 x 1 = 10

Q No.	Question	CO	Level
a.	Design a quantum protocol that uses noise-resilient quantum operations for secure information transfer.	6	K6
b.	Illustrate Shannon Entropy in the context of information theory. Suppose a source emits 4 symbols: A, B, C, and D with the following probabilities: **Symbol** – **Probability (P)** A – 0.5 B – 0.25 C – 0.125 D – 0.125 Calculate the Shannon Entropy of this source.	4	K

7. Attempt any *one* part of the following: 10 x 1 = 10

Q No.	Question	CO	Level
a.	Write the major steps involved in implementing Markov Processes in quantum computing.	4	K6
b.	Evaluate the advantages of fault-tolerant quantum computation in building scalable quantum systems. Justify.	3	K5