SRI VENKATESWARA COLLEGE OF ENGINEERING
(AUTONOMOUS)
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Question bank

Name of the Branch/Course	EEE/B.Tech
Subject	INTRODUCTION TO QUANTUM TECHNOLOGY AND APPLICATIONS
Subject Code	CS23AES501
Year & Sem	III YEAR & I SEM

2 Marks Questions

Unit – 1

1	Define the principle of superposition in quantum mechanics
2	What is quantum entanglement?
3	Mention any two differences between classical and quantum mechanics
4	What is the Heisenberg Uncertainty Principle?
5	What is meant by wave-particle duality?
6	State one application each of quantum computing and quantum communication.
7	Give one example of a quantum system
8	What is quantization in the context of energy levels?
9	Why are quantum technologies considered strategically significant?
10	Name any two countries actively pursuing national quantum missions.
11	What role do photons play in quantum communication?
12	How does quantum measurement affect the state of a quantum system?
13	What are discrete energy levels in an atom?
14	Mention any one global initiative in quantum technology.
15	How does quantum sensing differ from classical sensing?

Unit – 2

1	What is a qubit?
2	How does a qubit differ from a classical bit?
3	Define quantum coherence in simple terms.
4	What causes decoherence in a quantum system?
5	Mention one quantum system used to realize a qubit.
6	What is meant by the polarization of a photon?
7	How is quantum information different from classical information?

8	What is the role of Hilbert space in quantum mechanics?
9	Define entanglement in the context of quantum information systems.
10	State one philosophical implication of quantum randomness.
11	What does non-locality mean in quantum systems?
12	Mention one example each of a physical realization of a qubit using trapped ions and superconducting circuits.
13	What is the observer's role in quantum measurement?
14	Name two theoretical tools used to describe quantum states.
15	What is the importance of operators in quantum mechanics?

Unit – 3

1	Why are quantum systems considered fragile?
2	Define decoherence in the context of quantum computing
3	What is the role of error correction in quantum computers?
4	Mention one condition required for a functional quantum system.
5	Name two types of quantum hardware platforms.
6	Why is scalability important in quantum computing?
7	What makes maintaining quantum entanglement difficult?
8	What is meant by quantum noise?
9	How does isolation help in building a stable quantum system?
10	Mention one theoretical barrier in building a quantum computer.
11	Name one advantage and one limitation of superconducting circuits as a quantum platform.
12	How do trapped ions function as quantum hardware?
13	Give one difference between quantum hardware and classical hardware
14	State one role of quantum software in quantum computing
15	What is the current challenge with quantum stability?

Unit – 4

1	What is the key difference between quantum and classical information?
2	Define Quantum Key Distribution (QKD).
3	Mention one application of quantum communication.
4	What role does entanglement play in quantum communication?
5	What is the quantum internet?
6	Define quantum parallelism in simple terms.
7	How does a quantum gate differ from a classical gate?
8	State one challenge in quantum computing
9	What is the purpose of error correction in quantum systems?
10	Give one advantage of quantum communication over classical communication.
11	What is meant by "many states at once" in quantum computing?
12	Name two common types of quantum gates.
13	What is decoherence in the context of quantum computing?
14	Mention one real-world application of quantum computing.
15	What makes quantum networks more secure than classical networks?

Unit – 5

1	Name one application of quantum computing in healthcare.
2	What is quantum sensing used for?
3	Mention one use of quantum technology in logistics or optimization.
4	Name any two major companies working on quantum computing.
5	What role does Google play in the quantum industry?
6	Define quantum precision timing in one sentence.
7	What is a key ethical concern in the use of quantum technology?
8	List one challenge to the adoption of quantum technologies.
9	Name one emerging career role in the quantum industry.
10	What skillset is essential for a quantum software engineer?
11	Which Indian initiative is promoting quantum research and development?
12	How is Microsoft contributing to the quantum future?
13	Mention one societal impact of widespread quantum computing.
14	What is the main barrier to quantum workforce development?
15	Give one example of India's educational efforts in quantum technology

10 Marks Questions

Unit – 1

1	Explain in detail the transition from classical to quantum physics. What were the key motivations for developing quantum theory?
2	Discuss the fundamental principles of quantum mechanics: superposition, entanglement, and uncertainty. Explain with conceptual examples
3	Compare classical mechanics and quantum mechanics in terms of determinism, observables, and system behavior
4	Describe the concept of wave-particle duality and its experimental evidence. How did it challenge classical notions?
5	Explain quantum states and the nature of measurement. How does observation influence the outcome in a quantum system?
6	Give an overview of quantum systems such as electrons, photons, and atoms. How are they used in quantum technologies?
7	What is meant by quantization of energy? Explain its significance using the hydrogen atom or harmonic oscillator as an example
8	Why is quantum technology considered strategically important? Discuss its implications in national security, communication, and scientific advancement.
9	Provide a detailed overview of quantum technologies – quantum computing, quantum communication, and quantum sensing. Include use-cases.
10	Explain the quantum missions of at least three countries (e.g., India, USA, China, EU). What are their goals, investments, and focus areas?

Unit – 2

1	Explain the concept of a qubit using the examples of spin and polarization. How does it compare to a classical bit?

2	Discuss various physical implementations of quantum systems such as trapped ions, superconducting circuits, and photons. (Non-engineering perspective)
3	What are quantum coherence and decoherence? Explain their significance and challenges in quantum information systems.
4	Describe the abstract theoretical concepts of Hilbert spaces, quantum states, and operators in the context of quantum information.
5	Discuss the role of entanglement and non-locality in quantum information systems. How do they enable quantum advantages?
6	Compare classical and quantum information. Highlight the principles and fundamental differences.
7	Explain the philosophical implications of quantum theory in terms of randomness, determinism, and the role of the observer.
8	How does the concept of superposition enable quantum parallelism? Discuss with reference to qubit behavior.
9	Describe the challenges in maintaining coherence in quantum systems and the impact of decoherence on quantum computations.
10	Discuss how Hilbert space formalism supports quantum computing. Include the role of state vectors and operators.

Unit – 3

1	Discuss the fragility of quantum systems. Explain how decoherence, noise, and control challenges impact quantum computing.
2	What are the essential conditions for building a functional quantum computer? Explain the importance of isolation, error correction, scalability, and stability.
3	Why is maintaining entanglement in quantum computers theoretically challenging? Explain with relevant examples
4	Explain the need for quantum error correction. What theoretical models are proposed to manage errors in quantum systems?
5	Compare different quantum hardware platforms – superconducting circuits, trapped ions, and photonics – in terms of their strengths and limitations.
6	Discuss the theoretical and practical gap between the vision and current reality of quantum computing. What remains elusive?
7	Explain the role of quantum software in managing the theoretical complexities of quantum computing.
8	Describe how scalability and stability influence the design of quantum hardware systems. What are the associated challenges?
9	Explain how noise affects quantum computation and what methods are used to mitigate it.
10	Critically analyze the theoretical barriers to building a large-scale quantum computer. How close are we to overcoming these barriers?

Unit – 4

1	Compare classical and quantum information. Discuss their encoding, manipulation, and security aspects.
2	Explain the principles of Quantum Communication. Discuss the working of Quantum Key Distribution (QKD) with an example.

3	Describe the role of entanglement in quantum communication. How does it enable secure and instantaneous data transfer?
4	What is the Quantum Internet? Discuss its concept, potential benefits, and the challenges in its realization.
5	Explain the concept of quantum parallelism. How does it offer advantages over classical computing?
6	Compare classical and quantum gates. Give examples and describe how computation differs in the two models.
7	What are the major challenges in quantum computing? Discuss the issues of decoherence and error correction in detail.
8	Provide an overview of quantum computing. How does it differ from classical computing in terms of speed and complexity?
9	Discuss the future potential of quantum communication and computing. What are the expected real-world impacts?
10	Describe how quantum key distribution ensures secure communication. How is it superior to classical encryption techniques?

Unit – 5

1	Explain the application of quantum computing in real-world domains like healthcare, material science, and logistics. Provide suitable examples.
2	What is quantum sensing? Discuss its applications in precision timing and navigation.
3	Discuss industrial case studies of quantum technology adoption by IBM, Google, Microsoft, and PsiQuantum. How are these companies shaping the future of quantum?
4	What are the ethical, societal, and policy-related considerations of adopting quantum technologies?
5	Identify the challenges in the large-scale adoption of quantum technologies. Discuss aspects such as cost, skills gap, and standardization.
6	What are the emerging career opportunities in the field of quantum technologies? Discuss the required roles, skillsets, and preparation pathways.
7	Analyze the educational and research landscape in quantum science in India. How can India leverage its position in the global quantum race?
8	How can quantum computing transform the pharmaceutical industry? Provide a case-based explanation involving drug discovery.
9	Describe the future potential of quantum technologies across industries. What real-world impacts are expected in the next decade?
10	Evaluate India's opportunities and challenges in becoming a global quantum leader. What should be the strategic focus areas?