



MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(AN AUTONOMOUS INSTITUTION)

(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)

Accredited by NAAC with 'A' Grade & Recognized Under Section 2(f) & 12(B) of the UGC act, 1956

COURSE CONTENT

QUANTUM COMPUTING								
III Semester: CSE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2535821	Professional Core courses	L	T	P	C	CIA	SEE	Total
		3	0	0	3	40	60	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			
requisites: UG level course in quantum computing								

Course Overview:

The Quantum Computing course introduces the mathematical foundations and physical principles underlying quantum computation, including linear algebra, quantum mechanics, and qubit implementation. It covers quantum gates, circuits, architectures, and major quantum algorithms such as Shor's and Grover's algorithms

Course Objectives:

1. To understand the fundamentals of quantum computing and finite-dimensional mathematics.
2. To learn linear algebra, complex numbers, and quantum mechanics concepts used in quantum computation.
3. To study qubits, quantum gates, quantum circuits, and quantum computing architectures.
4. To analyze and implement major quantum algorithms such as Deutsch, Shor's, and Grover's algorithms.
5. To examine the impact of quantum computing on modern cryptography and security systems.

Course Outcomes: After Completion of the Course, Students should be able to

1. Understand the fundamental concepts of linear algebra, including matrices, vector spaces, set theory, and complex numbers, and apply algebraic operations to solve mathematical problems.
2. Analyze the principles of quantum physics, including quantum states, Hilbert spaces, entanglement, and uncertainty, and their role in quantum mechanics and quantum communication systems.
3. Evaluate quantum computing architectures, including qubits, quantum gates, circuits, and hardware challenges like decoherence, and different implementation approaches.
4. Apply major quantum algorithms such as Deutsch, Deutsch-Jozsa, Shor's, and Grover's algorithms in solving computational problems.
5. Analyze classical asymmetric cryptographic algorithms (RSA, Diffie-Hellman, ECC) and the impact of quantum computing on modern cryptographic systems and security applications.

Unit I

Introduction to Essential Linear Algebra

Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory
Complex Numbers

Definition of Complex Numbers, Algebra of Complex Numbers, Complex Numbers Graphically,
Vector Representations of Complex Numbers, Pauli Matrices, Transcendental Numbers

Unit II

Basic Physics for Quantum Computing

The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert
Spaces, Uncertainty, Quantum States, Entanglement

Basic Quantum Theory

Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics,
Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD,
Quantum Entanglement, Interpretation, QKE

Unit III

Quantum Architecture

Further with Qubits, Quantum Gates, More with Gates, Quantum Circuits, The D-Wave
Quantum Architecture

Quantum Hardware

Qubits, How Many Qubits Are Needed? Addressing Decoherence, Topological Quantum
Computing, Quantum Essentials

Unit IV

Quantum Algorithms

What Is an Algorithm? Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani
Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm

Unit V

Current Asymmetric Algorithms: RSA, Diffie-Hellman, Elliptic Curve

The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific
Algorithms, Specific Applications

TEXT BOOKS:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press
2. Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson

REFERENCE BOOKS:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. Basic Concepts, Vol
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms.

ELECTRONIC RESOURCES:

1. <https://nptel.ac.in/courses/106/106/106106197>
2. <https://quantum-computing.ibm.com/>
3. <https://www.coursera.org/learn/quantum-computing>
4. <https://www.geeksforgeeks.org/quantum-computing/>

MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Tech talk and Concept Video topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. E-Learning Readiness Videos (ELRV)

