PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY

(Autonomous)

Kanuru, Vijayawada-520007

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (Data Science)

III B. Tech II Semester

Quantum Computing

Course Code	23DS4602B	**Year**	III	**Semester**	II
Course Category	PE	**Branch**	CSE (Data Science)	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Applied Physics, Mathematics
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		
Upon Successful completion of course, the student will be able to		
CO1	Describe the interdisciplinary foundations of quantum computing involving mathematics, physics, and biology, and differentiate classical and quantum computing paradigms to *understand their principles and potential applications*	**L2**
CO2	**Apply** mathematical and physical principles to model and analyze qubits, quantum gates, and circuits including the Bloch sphere and entanglement.	**L3**
CO3	Use quantum algorithms such as Deutsch's, Deutsch-Jozsa, Shor's, and Grover's algorithms with quantum logic gates and circuits to *solve computational problems efficiently*.	**L3**
CO4	**Analyze** quantum error correction methods, quantum information theory, and quantum cryptography mechanisms for secure quantum communication to *assess quantum security techniques for practical communication systems*	**L4**

Contribution of course outcomes towards achievement of program outcomes & Strength of correlations (3: Substantial,2: Moderate,1: Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PSO1	PSO2
CO1	2												
CO2	3												
CO3	3												
CO4		3									2		

PVP 23

PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY

(Autonomous)

Kanuru, Vijayawada-520007

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (Data Science)

III B. Tech II Semester

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	History of Quantum Computing: Importance of Mathematics, Physics and Biology. Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical operations	CO1
II	**Background Mathematics:** Basics of Linear Algebra, Hilbert space, Probabilities, and measurements. **Background Physics:** Paul's exclusion Principle, Superposition, Entanglement and super-symmetry, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis. Background Biology: Basic concepts of Genomics and Proteomics (Central Dogma)	CO1, CO2, CO4
III	**Qubit:** Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.	CO1, CO2, CO4
IV	**Quantum Algorithms**: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm.	CO1, CO3, CO4
V	**Noise and error correction:** Graph states and codes, Quantum error correction, fault-tolerant computation. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation	CO1, CO3, CO4

Learning Resources

Text Books

1. Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang, 10th Anniversary Edition, 2010, Cambridge University Press

References

1. Quantum Computing for Computer Scientists, Noson S. Yanofsky and Mirco A. Mannucci, 1st Edition, 2008, Cambridge University Press.
2. Principles of Quantum Computation and Information, Vol. I: Basic Concepts & Vol. II: Basic Tools and Special Topics, Giuliano Benenti, Giulio Casati, and Giuliano Strini, 1st Edition, 2004 & 2007, World Scientific Publishing.
3. An Introduction to Quantum Computing Algorithms, Arthur O. Pittenger, 1st Edition, 1999, Springer.

E-Recourses and other Digital Material

1. https://onlinecourses.nptel.ac.in/noc25_cs95/preview