PVP 23

PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous) Kanuru, Vijayawada-520007
Department of Computer Science & Engineering (AI&ML)
IV B. Tech – I Semester

Quantum Computing

Course Code	23AM4701C	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE (AI&ML)	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	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 fundamentals of quantum computing — qubits, circuits, algorithms, and quantum information concepts — to learn their working and applications.	**L2**
CO2	Apply mathematical and physical concepts to model qubits and design basic quantum circuits	**L3**
CO3	Use quantum algorithms, error correction techniques, and quantum information concepts to solve computational and cryptographic problems	**L3**
CO4	Analyze qubit systems, quantum circuits, algorithms, error correction techniques, and quantum information concepts to evaluate their performance and applications.	**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	PO10	PO11	PSO1	PSO2
CO1	2												
CO2	3												
CO3	3												
CO4		2									3		

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
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, Nielsen, M. A.; Chuang, I. L., 10th Anniversary Edition, 2010, Cambridge University Press
References
1. Quantum Computing for Computer Scientists, Yanofsky, N. S.; Mannucci, M. A., 1st Edition (Latest), 2008, Cambridge University Press. 2. Principles of Quantum Computation and Information (Vol. I: Basic Concepts; Vol. II: Basic Tools and Special Topics), Benenti, G.; Casati, G.; Strini, G., 1st Edition (Latest), 2004 (Vol. I), 2007 (Vol. II), World Scientific. 3. An Introduction to Quantum Computing Algorithms, Pittenger, A. O., 1st Edition (Latest), 1999, Birkhäuser.
E-Recourses and other Digital Material
1. https://onlinecourses.nptel.ac.in/noc25_cs95/preview 2. https://learning.quantum.ibm.com/