Quantum Computing

Course Code	23EC2502	**Year**	III	**Semester**	I
Course Category	OE-1	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		**BL**
CO1	Understand the elements and goals of quantum computing	L2
CO2	Analyze quantum states and operations mathematically	L4
CO3	Build simple quantum gates and circuits	L3
CO4	Analyze the applications of quantum computing	L4

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3				2						2	3	
CO2	3	3			2						2	3	
CO3	3	3			2						2	3	
CO4	3				2						2	3	
Average	3	3			2						2	3	

SYLLABUS		
Unit No	**Contents**	**Mapped CO**
1	**Introduction to Quantum Computing:** Moore's law & its end, Motivation for studying Quantum Computing, Differences Between Classical and Quantum Computing ,Concept of Qubit, Properties of Qubits, Representation of Qubits, Single and Two qubits and Extension to N qubits , superposition, Types of Quantum Computers: Superconducting, Photonic, Trapped Ions, Silicon spin qubits, , Major players in the industry (IBM, Microsoft, Google etc)	CO1
2	**Math Foundation for Quantum Computing** :Column and Row Matrices, Matrix Operations, Matrix Representation of 0 and 1 States. Identity Operator, Pauli Matrices, Conjugate of a Matrix, Transpose of a Matrix, Hermitian Matrix, Unitary Matrix, Inner Product - Multiplication of Row and Column Matrices, Probability, Orthogonality. Orthonormality, inner product and, tensors, unitary operators, Eigen values and Eigen vectors.	CO2
3	**Quantum Gates :** Single Qubit Gates: Quantum Not Gate, Pauli-X,Y and Z Gates,	CO3

	Hadamard Gate, Phase Gate, T- Gate, S- Gate, Multiple Qubit Gates: Controlled Gates, Controlled Not Gate or CNOT Gate, Swap Gate, Controlled Z Gate, Toffoli Gate, Reversible Computation & Reversible-Gates.	
4	**Quantum algorithms**: Deutsch's algorithm, Deutsch-Jozsa algorithm**,** Shor's algorithm, quantum searching and Grover's algorithm	CO4
5	**Quantum Computing Applications:** Public key Cryptography, Private key Cryptography**,** Quantum key distribution(**QKD)**, Quantum Teleportation, Superdense coding.	CO4

Learning Resources

Text Books

1. 1.M A Nielsen and I L Chuang , Quantum Computation and Quantum Information, Cambridge University Press
2. 2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University press.

References

1. Parag K. Lala ,Quantum Computing: A Beginner's Introduction, Mc Graw Hill Education

e-Resources:

1. https://nptel.ac.in/courses/106106232