GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Computer Science & Engineering

Subject Name **Quantum Theory & Algorithm Design.**

Sr.No	Course content
1.	Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt ortho gonalization, bra-ket formalism, the Cauchy-schwarez and triangle Inequalities.
2.	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decompostion, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators, Commutator Algebra, Heisenberg uncertainty principle, polar decomposition & singular values, Postulates of Quantum Mechanics.
3.	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices.
4.	Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.
5.	Quantum Measurement Theory : Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures.
6.	Introduction Mathematics for Algorithmic: Sets, Functions and Relations. Amortized Analysis: Properties of Matrices, Solving systems of linear Equations, Linear programming, general linear programs, an overview of linear programming The Greedy Methods: Optimization problems, the greedy method, 0/1 knapsack problem, topological sorting, Single source shortest path, minimum cost spanning tree. Divide & Conquer: The method. Application: merge sort. Dynamic programming: The method, Application: 0/1 knapsack problem Skip lists and hashing. Priority Queues: Huffman Codes. Binary Search Trees: Binary search trees, indexed binary search trees,bineary search tree operations and implementation. Graphs. Basic Data Structures: Tree, The tree Abstract Data type, Tree Traversal, Binary tree.

Reference Books :

1. Quantum Computing without Magic by Zdzis_law Meglicki
2. Quantum Computing Explained By DAVID McMAHON
3. Quantum Computer Science By Marco Lanzagorta, Jeffrey Uhlmann
4. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca
5. Introduction to Algorithms by Thomas H. Cormen, Leiserson, Rivest & Stein.
6. Data Structures, Algorithms & Applications in C++ by Sartaj Sahni.
7. Algorithm Design by Michael T. Goodrich.