

# Quantum Computing

By Dr. Vishwanath Rao

## Day 1

### Introduction to Quantum Computing

- Quantum Mechanics
- Qubits and Quantum Memory
- Elementary Gates

### Overview of Circuit Model and Deutsch-Jozsa

### Introduction to Simon's Algorithm

### The Fourier Transform

- Classical Discrete Fourier Transform
- Fast Fourier Transform
- Application – Multiplying Two Polynomials
- Quantum Fourier Transform
- Quantum Circuit

### Shor's Factoring Algorithm

### Hidden Subgroup Problem

## Day 2

### Grover's Search and Quantum Walk Algorithm

- Grover's Algorithm
- Amplitude Amplification
- Application: Satisfiability
- Quantum Walk
- Applications

- Grover Search
- Collision Problem
- Finding a Triangle in Graph

## **Overview of Hamiltonian Simulation**

### **Introduction to HHL Algorithm**

- Linear Systems Problem
- HHL Algorithm for Linear Systems
- Improving HHL Algorithm Complexity

### **Quantum Query Lower Bounds Quantum Complexity Theory**

## **Day 3**

### **Quantum Encodings with a Non-Quantum Application Quantum Communication Complexity**

### **Entanglement and Non-Locality**

- Quantum Non-Locality
- CHSH: Clauser-Horne-Shimony-Holt
- Magic Square Game

### **Introduction to Quantum Cryptography**

### **Error-Correction and Fault-Tolerance**

- Introduction
- Classical Error-Correction
- Quantum Errors
- Quantum Error-Correcting Codes
- Fault-Tolerant Quantum Computation
- Concatenated Codes and Threshold Theorem