

Course Title: Quantum Information Theory

Credit Hrs: 3

Prerequisites: Quantum mechanics background

Course Description:

The course involves studying how quantum systems process and transmit information, covering topics like quantum bits, superposition, entanglement, quantum gates, and quantum algorithms. The course builds a mathematical foundation, starting with concepts from classical information theory and moving on to the axioms of quantum theory, quantum channels, and their capacities. Finally, they discuss applications such as quantum cryptography, quantum computing, and quantum error correction.

Course Objectives:

1. Understand quantum information processing concepts
2. Master quantum entanglement and communication protocols
3. Analyze quantum information transmission and storage

Course Learning Outcomes: Students will be able to:

1. Quantify quantum information using entropy measures
2. Design quantum communication protocols
3. Analyze quantum error propagation
4. Implement quantum information processing algorithms

Course Contents:

Week	Contents
1-2	Classical vs. quantum information
3-4	Quantum entropy and mutual information
5-6	Quantum entanglement quantification
7-8	Quantum communication protocols
9-10	Quantum teleportation and dense coding
11-12	Quantum error models
13-14	Quantum channel capacity
15-16	Applications in quantum networks

Textbooks/ References:

1. Wilde, M.M. "Quantum Information Theory" 2nd Edition (2017)
2. Preskill, J. "Quantum Information and Computation" (2018)

Assessments:

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| 1. Assignments: | 10% |
| 2. Quizzes: | 10% |
| 3. Midterm Exam: | 30% |
| 4. Final Exam: | 50% |