Phys 4308	QUANTUM INFORMATION THEORY	(CR3)
Preq.	Phys 3301/ ADP (Physics)	

Objectives

To understand the fundamental concepts of quantum information, communication, computation, and physical protocols for quantum computation

Syllabus

Review of Quantum Mechanics and overview of Quantum information: Postulates of quantum mechanics, quantum states and observables, Dirac notation, projective measurements, density operator, pure and mixed states, entanglement, tensor products, no-cloning theorem, mixed states from pure states in a larger Hilbert space, Schmidt decomposition, generalized measurements, (CP maps, POVMs), qualitative overview of Quantum Information. Quantum Communication: Dense coding, teleportation, entanglement swapping, instantaneous transfer of information, quantum key distribution. Entanglement and its Inseparability of EPR pairs, Bell inequality for pure and mixed states, entanglement witnesses, Peres- Horodecki criterion, properties of entanglement measures, pure and mixed state entanglement, relative entropy as entanglement measure, entanglement and thermodynamics, measuring entanglement. Quantum Information: Classical information theory (data compression, Shannon entropy, von Neumann entropy), fidelity, Helstrom's measurement and discrimination, quantum data compression, entropy and information, relative entropy and its statistical interpretation, conditional entropy, Holevo bound, capacity of a quantum channel, relative entropy and thermodynamics, entropy and erasure, Landauer's erasure.

Recommended Books

1. *Introduction to Quantum Information Science by V. Vedral, Oxford (2007)*
2. *Quantum Computation and Quantum Information by M. Nielsen and I. Chuang (10^{th} Edition), Cambridge (2010)*
3. *Problems and Solutions in Quantum Computing and Quantum Information by W. Steeb and Y. Hardy (3^{rd} Edition), World Scientific Publishing (2011)*