COOPERATIVE PHENOMENA IN CLASSICAL & QUANTUM SYSTEMS(PHY690Q)

Students are expected to complete a course on quantum mechanics (for example, at the level of Phy431) and a course on statistical mechanics (for example, at the level of phy412)

Instructor: **Amit Dutta**

Module I: Cooperative Phenomena, superfluidity and super-conductivity and quantum coherence: Lectures 20

Bose-Einstein condensation, A brief note on basic phenomenology of superfluidity and superconductivity, Landau theory of superconductivity and Abelian Higgs model, BCS theory, the macroscopic coherent state, Josepshon junctions and applications, flux qubit, charge qubits and connection to quantum information studies.

Books: 1. James F. Annett, Superconductivity, superfluids and condensates.

2. Tinkham, Superconductivity

Module II: Quantum Phase transition, topology and information: Lectures 15

Quantum Phase Transitions in spin systems Cooperative phenomena in topological systems. SSH, Haldane, Kitaev models, topological phase transitions. Connection to quantum information.

Books: 1.Issac Chuang and Michael Nielsen, Quantum computation and quantum information.
2. Dutta et al, Quantum phase transitions in transverse field spin models: from statistical physics to quantum information, Cambridge University Press (2015).
3. Shun-Qing Shen, Topological Insulators: Dirac Equation in Condensed Matter

Module III: Dynamics of many body systems. Lectures 10

Dynamics of classical and quantum spin systems. Nucleation and Spinodal decomposition. A brief note on open quantum systems.

1. Chaikin and Lubesnsky

2. Open quantum system: Breuer

Course arrangement may be altered in consultation with the students.