Special Topics Course PHY690N - Correlated Electrons and Quantum Magnetism Semester : 2022-I, Credits [9] Instructor: Avinash Singh

Course Objective: Microscopic understanding of magnetic ordering, anisotropy, and excitations in terms of realistic multi-orbital correlated electron models. Focus will be on many body theory including self energy and vertex corrections, and understanding detailed momentum dependence of magnetic and electronic excitations probed experimentally using Inelastic Neutron Scattering, Angle Resolved Photo Emission Spectroscopy, Spin Polarized Electron Energy Loss Spectroscopy, Resonant Inelastic X-ray Scattering.

Topics covered:

- 1. Quantum Antiferromagnetism in the Hubbard Model (Cuprates)
- 2. Spin Fluctuation Propagator and Quantum Corrections
- 3. Metallic Ferromagnetism (3d Transition Metals)
- 4. Correlated Motion of Electrons
- 5. Spin-Charge-Orbital Ordering in Doped Manganites (La1-xSrxMnO3)
- 6. 5d Systems with Strong Spin-Orbit Coupling (SOC) (Iridates)
- 7. Spin-Orbital Entanglement and Magnetic Excitations (Sr2IrO4)
- 8. Magnetic Ordering, Anisotropy, and Excitations in Ca2RuO4
- 9. Interplay of SOC, Structural Distortions, and Coulomb Interactions
- 10. SOC Induced Easy Plane Anisotropy Magnetic Anisotropy Energy
- 11. Octahedral Tilting Induced Easy Axis Anisotropy
- 12. Self Consistent Determination of Magnetic Order
- 13. Orbital off-diagonal Spin and Charge Condensates
- 14. Interaction Induced SOC Renormalization and Orbital Moments

Evaluation: based on performance in assignments and course project.