Special Topics Course
PHY690N - Correlated Electrons and Quantum Magnetism
Semester : 2023 - I, Credits [9]
Instructor: Avinash Singh

Course outline: microscopic understanding of Magnetic Ordering, Magnon Excitations, and Quantum Spin Fluctuations in terms of realistic Correlated Electron Models on different lattices; Many Body Theory - Self Energy and Vertex Corrections; composite Spin-Orbital order and coupled Spin-Orbital fluctuations in Spin-Orbit coupled systems; understanding detailed momentum dependence of Magnetic, Orbital, and Electronic Excitations probed experimentally using Inelastic Neutron Scattering, Angle Resolved Photo Emission Spectroscopy, Resonant Inelastic X-ray Scattering.

Topics will include:

1. Quantum Antiferromagnetism and Hole Dynamics (Cuprates)
2. Quantum Corrections in a Metallic Ferromagnet (3d Transition Metals)
3. Ferromagnetism in Diluted Magnetic Semiconductors ($Ga_{1-x}Mn_xAs$)
4. Spin-Charge-Orbital Ordering in Doped Manganites ($La_{1-x}Sr_xMnO_3$)
5. 120^o AFM order in Triangular Lattice Systems ($HoMnO_3$,$YMnO_3$)
6. Magnetic Frustration and Excitations in fcc Lattice System (MnS_2)
7. 5d Systems with Strong Spin-Orbit Coupling (SOC) (Iridates, Osmates)
8. Spin-Orbital Entanglement and Magnetic Excitations (Sr_2IrO_4)
9. Magnetic Ordering and Excitations in Ca_2RuO_4
10. SOC Induced Magnetic Anisotropies
11. Orbital Mixing Spin and Charge Condensates
12. Interplay of SOC, Structural Distortions, and Coulomb Interactions
13. Unified approach for determining composite Spin-Orbital Order and coupled Spin-Orbital Fluctuations (in iridate, ruthenate, osmate, chromate, and vanadate compounds with 5d, 4d, 3d ions having n=5,4,3,2,1 electrons in the t2g sector)

Course Material: Lecture Notes + Publications (INS, ARPES, RIXS expts.)
Evaluation: based on performance in assignments and course project.